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The Craniometry of Southern New England Indians

BY
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YALE UNIVERSITY PRESS
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INTRODUCTION.

It has long been a reproach to American Anthropology that so little available material exists in the way of anthropometric data concerning either the skull or the other bones of our aborigines. This is the more remarkable, too, since Morton, the Father of Physical Anthropology in this country, inaugurated this branch of study in the New World by careful measurements of hundreds of crania, especially those of American Indians. But "he was a father who left many friends to the science and even followers, but no real progeny" [Hrdlicka, in Amer. Anthropol., 1914, p. 523], and thus it happens that, while many lines of anthropological research have flourished greatly, but little building material has ever been deposited upon the craniometric foundations laid by the great master. To be sure, much has been done along the lines of descriptive craniology, but in the sense in which the Fuegians have been studied by Martin, the Ainus by Koganei, and the inhabitants of Cameroon by Drontschilow, to name a few of the best, the skull of the American Indian remains but little known.

The best model known to me along this line is the paper by Carr, 1880, who presented numerous careful measurements of the crania of New England Indians; but this paper is now thirty-five years old; it was written when there were great differences both in the measurements taken by different individuals and in the manner of taking them, when the instruments used were almost as individual as the measurements, when there was neither a Frankfort Horizontal nor an International Prescription.

With this need in mind I began some time ago to make a series of measurements upon a few local aboriginal crania collected in and about the town of Hadley, Mass., and shown to be absolutely genuine by the associated objects or the mode of burial. To this I added a few more from local excavations, now in the Gilbert Collection of Amherst College. Since, however, the time and opportunity failed me for continuing this work, I entrusted the entire matter to my pupil, Miss Knight, whose paper, compiled in the Anthropological Laboratory of Smith College, is here presented.

It will be noticed from the list of localities given in Appendix that the skulls studied are confined to the states of Massachusetts and Rhode Island, with the exception of two individuals from Farmington, Connecticut, whose close kinship to the other "river Indians," like the Agawams of Springfield and Longmeadow, is beyond dispute.

This distribution will include the territories of the Narragansetts, the Eastern Niantics, the Wampanoags, the Nipmucs, the Massachusetts, and the various divisions of the Connecticut River Indians (Agawam, Nonotuck, Pocumtuck), together with the tribes of the Massachusetts seaboard, north of Boston, chiefly tributaries of the Pennacook; and since the presumable date of the graves from which the skulls were obtained was at the earliest not many centuries before the colonization by the Whites, it is safe to assume that all the individuals taken were from an homogeneous Algonkin stock. It will thus be noted that there is no inclusion of the Pequot-Mohegan intruders, who seem to have come from the middle Hudson region some generations before the advent of the Whites, and which, although definitely Algonkin, may not have been quite so closely related as were the others. Thus it would seem that the material here treated is that of a single aboriginal type, or expanded family, and that the individual differences are only such as would be expected under such conditions.

HARRIS HAWTHORNE WILDER.

Smith College, January 12th, 1915.

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PROBLEM.

The following investigation is an attempt to determine as accurately and as completely as possible, by the anthropological methods in use at present, the racial cranial characteristics of the Southern New England Indian.

MATERIAL.

The material was obtained from the collections at Smith College; Amherst College; Peabody Museum, Cambridge; Park Museum, Providence; one, from the Public Library of Holyoke; three, from Phillips Andover Academy; and several from Charles Carr, Warren, R. I. Only those skulls were selected which, from the places of burial, were known to be probable members of the closely related Algonkian tribes; Nipmucks, Massachusetts, Niantics, Narragansetts, and Wampanoags. Therefore, no attempt is made to make any statement in regard to the American Indian in general, but merely concerning those of this restricted area.

I am deeply indebted to Dr. Harris Hawthorne Wilder, under whose direction this work has been carried on, for his preliminary instruction and constant advice; I wish also to express my appreciation of the many kindnesses extended to me, during my visits at Amherst and Cambridge, by Prof. John Mason Tyler, Prof. Frederic Brewster Loomis and Mr. Harold Plough at Amherst and by Mr. Charles C. Willoughby and Dr. Ernest Hooton at Cambridge. Acknowledgement is due to Mr. Warren King Moorehead, Mr. Charles Carr, Mr. Frank G. Willcox, and Mr. Harold L. Madison for the use of their material.

LENGTH-BREADTH INDEX.

The extremes of variation in the greatest length line in the male are between 169 and 206.5 mm.,* the average length being 182.2. For the female, the extremes are 158 and 188 mm., the average, 175.5 mm.

The greatest breadth in the male lies between 120 and 151 mm., the average, 134 mm.; for the female, 124 and 145 mm. with an average of 132 mm.

There seems to be a slight sexual difference; the females are not only smaller but also somewhat broader, i. e., more brachycephalic.

The frequency curves of the length-breadth indices, figures 1 and 2, show the modes for the females to be 76 and 79 with two smaller ones at 70 and 73 or 74. This curve, therefore, seems to have no clearly defined mode, due, no doubt, to lack of numbers. One might

* An unusually large skull found in Warren, R. I. From the location and from the associated objects in the grave with the body, it was undoubtedly the skull of an important Wampanoag sagamore or councillor, of the mid-seventeenth century.

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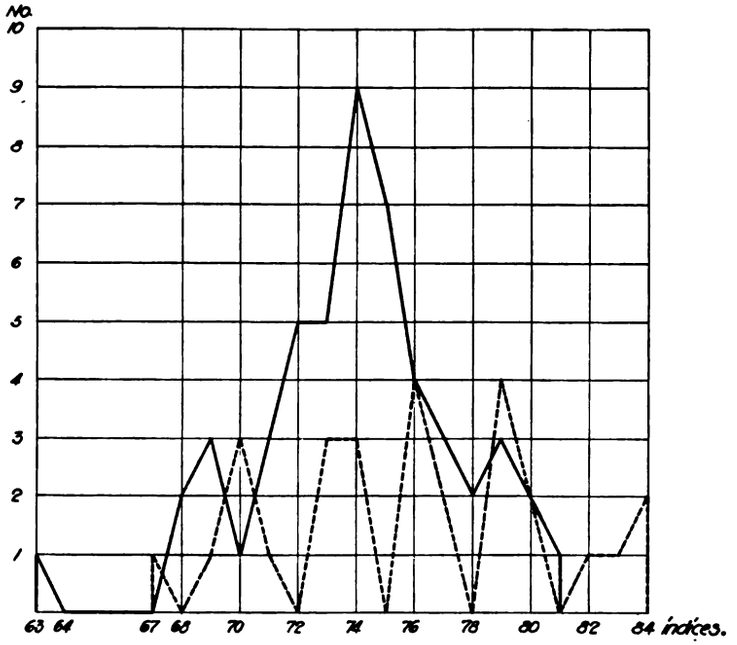
LENGTH-BREADTH INDICES.

NEW ENGLAND INDIANS.



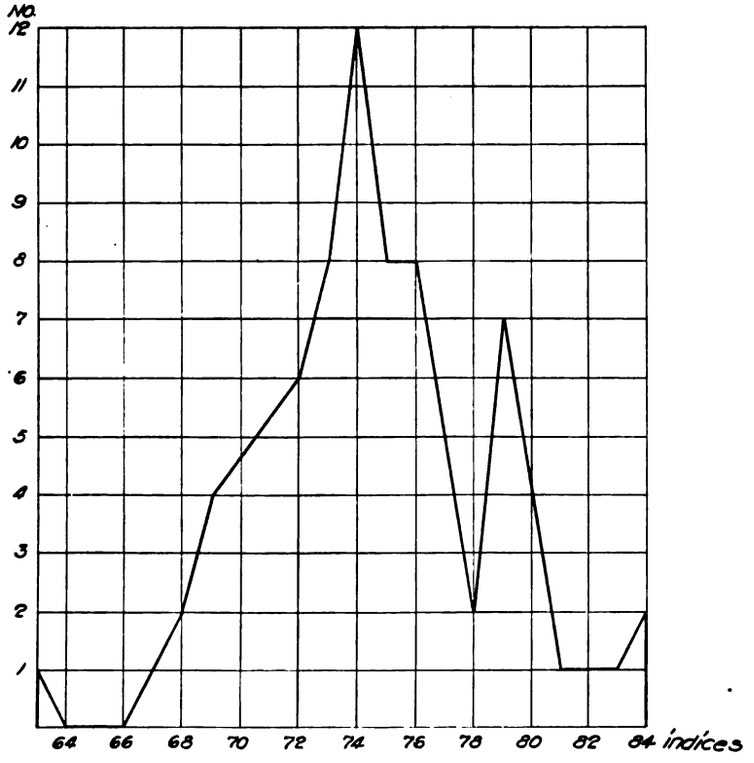
—— MALES 48 EXTREMES 81.5..63 4

---- FEMALES 29 EXTREMES 84.4..67.0

FIG. 1

LENGTH-BREADTH INDICES,

NEW ENGLAND INDIANS.



77 INDIVIDUALS BOTH MALE AND FEMALE

FIG. 2

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expect it to come at 75, which is the average of the indices. It is noticeable that the extremes for the female tend more toward the brachycephalic than the dolichocephalic end of the figures, while the males are the reverse. The males have a very clearly defined mode at 75. These same conclusions are reached from a study of the table given here (Table I). The fact that there are no skulls under the class hyperbrachycephalic is significant.

TABLE I.

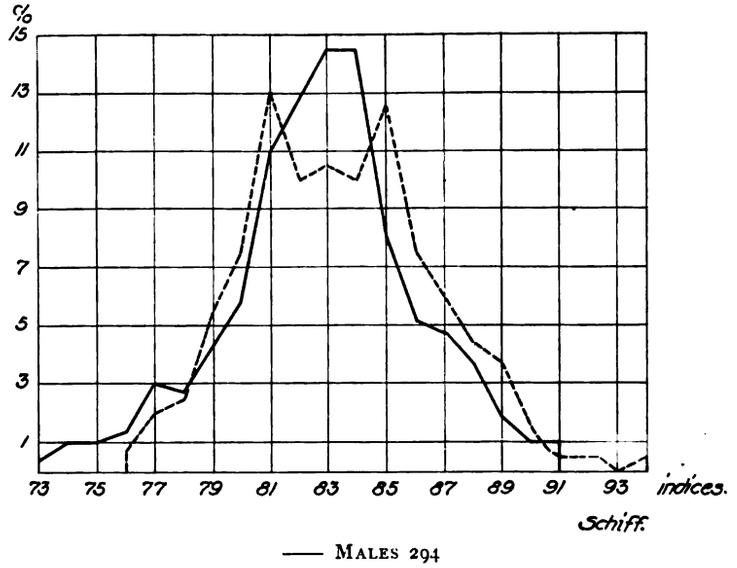
LENGTH-BREADTH INDICES.

Index Group		Male		Female	
		Number	Percent	Number	Percent
Hyperdolichocephalic	up to 69.9	7	14.5	2	6.8
Dolichocephalic	70.0–74.9	23	47.8	12	41.3
Mesocephalic	75.0–79.9	15	31.2	11	37.9
Brachycephalic	80.0–84.9	3	6.2	4	13.7
Hyperbrachycephalic	85.0 and over	0	0	0	0

In the Czechs, a good type of broad heads, the modes of the frequency curves of the length-breadth indices for the males and females lie at 79 and 83 and the range of variation is from 73 to 94, figure 3.

LENGTH-BREADTH INDICES.

CZECHS.



—— MALES 294

---- FEMALES 160

FIG. 3

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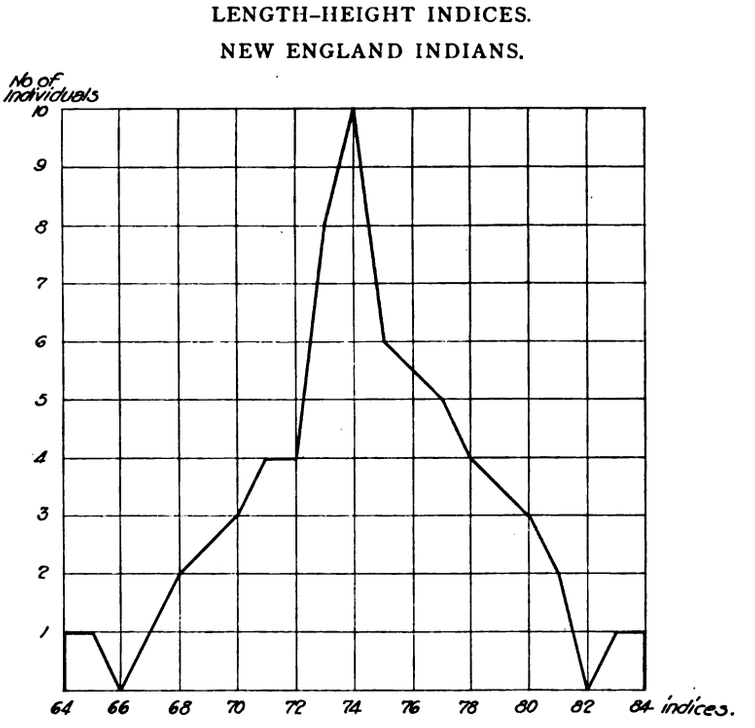
LENGTH–TOTAL HEIGHT INDEX.

The average length-total height index, the latter taken from basion to bregma, in the male is 74.73 and in the female 75.9, figure 4, showing that the females have a slightly higher head than the males. While 60% of the females are in the Hypsicephalic Class,



65 INDIVIDUALS

FIG. 4

57.5% of the males are Orthocephalic, Table II. The extremes between which the indices vary in the female are 65.57–84.12; in the male, 64.36–81.67, showing again a tendency on the part of the female to a relatively higher head. The actual average total height of the female, 133.2 mm., is, of course, less than that of the male, 136 mm.

TABLE II.

LENGTH–HEIGHT INDICES.

Index Group		Female		Male	
		Number	Percent	Number	Percent
Chamaecephalic	up to 69.9	4	16	3	7.5
Orthocephalic	70.0–74.9	6	24	23	57.5
Hypsicephalic	75.0 and over	15	60	14	35.0

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LENGTH-AURICULAR HEIGHT INDEX.

Using the auricular height instead of the basion-bregma height in determining the relation between the length and height of the skull, we find both males and females are in the Hypsicephalic Class, with average indices of 63.19 and 65.14 respectively. The actual average auricular height in the female is 113.59; male, 115.4. This leads to the conclusion that the female skull is slightly longer relatively from the auditory meatus to the base.

TABLE III.

SCALE OF LENGTH–HEIGHT INDICES.

Chamaecephalic	up to 57.9
Orthocephalic	58.0–62.9
Hypsicephalic	63.0 and over

SUPERIOR FACE.

The face on the living may be conveniently divided into three areas, (1) the forehead, which is bounded by the eyebrows, (2) the superior face, between the eyebrows and the mouth opening, and (3) the lower face, the remaining portion, the mandible. These do not correspond with the anatomical divisions of the skull; for example, the upper boundary of the forehead is the somewhat variable hairline which is of course absent on the skull, and the study of the forehead is most naturally included in connection with the frontal bone. The lower face, i. e., the mandible, is detached from the cranium and is adjustable only with some difficulty, thus forming a source of error; moreover, it is very often either missing entirely or broken. Hence, the superior face seems to offer the most satisfactory field for study. The different types of superior face are best demonstrated by the index of the height and breadth lines. A low index means a broad face, chamaeprosopic, while a high one shows a long and narrow face, leptoprosopic. The superior facial index is found by dividing the distance between the nasion and prosthion by the bizygomatic distance as a unit. Thus $\frac{n-pr \times 100}{zy-zy}$ = superior facial index. See Table IV.

TABLE IV.

SCALE OF SUPERIOR FACIAL INDICES.

Hyperchamaeprosopic	up to 44.9
Chamaeprosopic	45–49.9
Mesoprosopic	50–54.9
Leptoprosopic	55–59.9
Hyperleptoprosopic	60 and over

The average superior facial height for the female is 67.3 mm., the average breadth is 127.6 mm.; for the male they are 69.2 mm. and 132.0 mm. respectively. It is noticeable that while the average indices are the same for the two sexes, showing the same relative facial proportions, yet the actual size of the female is smaller and its limits of variation more nearly approach the mean. The average index, 52.7, which was found by taking the average of all the indices and, as a check, by finding the index of the average facial length

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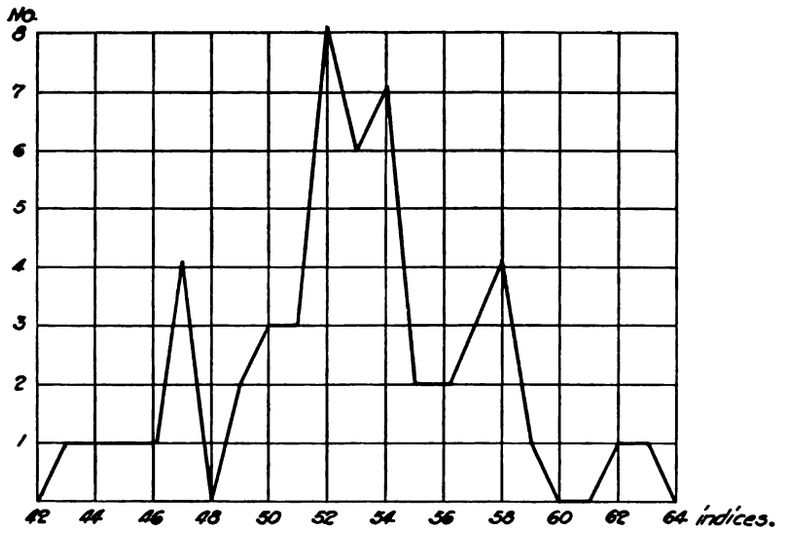
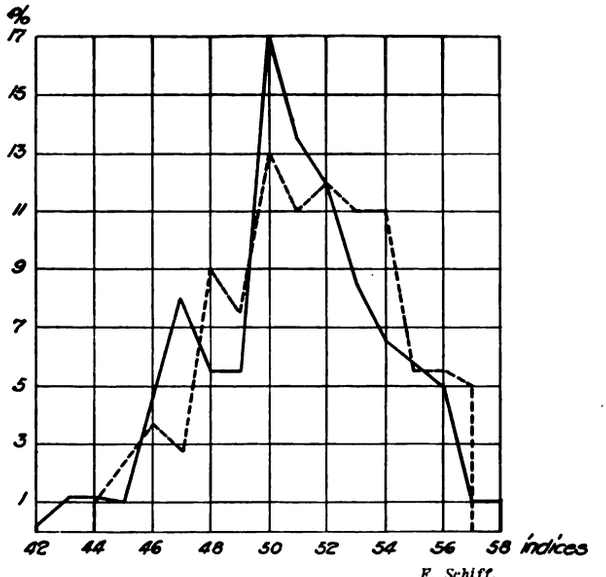
SUPERIOR FACIAL INDICES.
NEW ENGLAND INDIANS.



49 INDIVIDUALS

FIG. 5

SUPERIOR FACIAL INDICES.
BOHEMIANS.



—— 265 MALES
---- 157 FEMALES

FIG. 6

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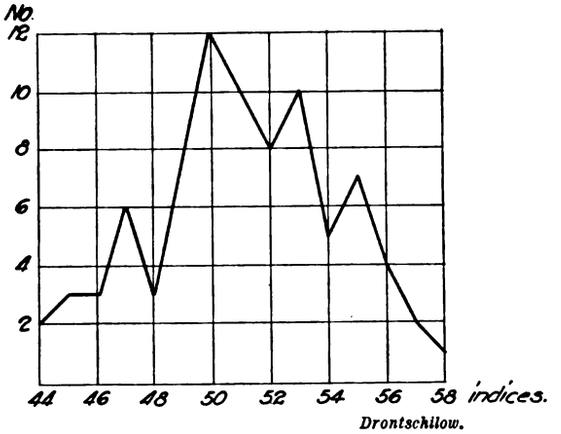
and breadth, is the same as the mode of the frequency curve of these indices which signifies a comparatively small number of extremes.

The frequency curves in figures 5, 6, and 7, show that the typical facial index of the Southern New England Indian is 52.7, that of the Czech (Bohemian) 50 (Schiff 1912);

SUPERIOR FACIAL INDICES.

AFRICAN NEGROES (KAMERUNS).



84 INDIVIDUALS

FIG. 7

and that of the African Negro, 50 (Drontschilow 1913). These comparative figures show that the typical face of the New England Indian is somewhat narrower than that of the Negro or Slav.

Tables V and VI show the percentage of individuals falling under the five different classes of broad or narrow faces. A comparison shows that among the specimens measured, there were no females in the Hyperleptoprosopic Class and a smaller percent than among the males in the class Hyperchamaeprosopic, another example of the conservatism of the female.

TABLE V.

SUPERIOR FACIAL INDICES.

Males.	Percent
Hyperchamaeprosopic	9.4
Chamaeprosopic	15.6
Mesoprosopic	56.2
Leptoprosopic	12.5
Hyperleptoprosopic	6.2

Extremes 42.75–62.71.

TABLE VI.

SUPERIOR FACIAL INDICES.

Females.	Percent
Hyperchamaeprosopic	5.8
Chamaeprosopic	17.6
Mesoprosopic	47.0
Leptoprosopic	29.4

Extremes 43.51–58.59.

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TOTAL FACIAL INDEX.

The total facial index could be obtained in only a very few specimens because the mandible was either entirely missing or badly broken. The average index of 10 females, Table VII, is 87.84; of 17 males, 84.33.

TABLE VII.

TOTAL FACIAL INDICES.

Index Group		Females		Males	
		Number	Percent	Number	Percent
Hyperchamaeprosopic	up to 74.9	0	0	1	5.88
Chamaeprosopic	75.0–84.9	3	30	8	47.06
Mesoprosopic	85.0–89.9	4	40	5	29.41
Leptoprosopic	90.0–99.9	3	40	3	17.65
Hyperleptoprosopic	100.0 and over	0	0	0	.0

The females show a tendency to be more mesoprosopic, while the males are more chamaeprosopic. This is in accord with the conclusions obtained from a study of the superior facial indices.

A possible correlation between the shape of the head and that of the face, which suggests itself in this connection, is shown by combining the Length-Breadth and Superior Facial Indices, and calculating the percentage of each combination (Table VIII). From this it will be seen that 29.5% of the Dolichocephalic skulls, and 12.2% of the Mesocephalic skulls are Mesoprosopic. 10.2% of the Mesocephalic skulls are Leptoprosopic. These results do not bear out the idea of correlation.

TABLE VIII.

COMBINATION OF LENGTH-BREADTH AND SUPERIOR FACIAL INDICES.

	Hyperchamaeprosopic up to 44.9	Chamaeprosopic 45.0–49.9	Mesoprosopic 50.0–54.9	Leptoprosopic 55.0–59.9	Hyperleptoprosopic 60 and over
up to 69.9 Hyperdolichocephalic	0	0	3– 5.9%	1– 2.0%	2–4.0%
70.0–74.9 Dolichocephalic	0	3–5.9%	14–29.5%	2– 4.0%	0
75.0–79.9 Mesocephalic	3–5.9%	4–8.1%	6–12.2%	5–10.2%	0
80.0–84.9 Brachycephalic	0	1–2.0%	4– 8.1%	1– 2.0%	0
85.0–89.9 Hyperbrachycephalic	0	0	0	0	0

NASAL INDEX.

The nasal height, taken from nasion to naso-spinale, varies from 39-57 mm., with an average of 50.33 mm. The breadth varies from 21-31 mm., with 25.77 mm. as the average. The mode of the frequency curve of the nasal indices is at 50.0, figure 8, showing that the larger number of indices fall in the classes Mesorrhine and Chamaerrhine. See Table IX.

TABLE IX.

NASAL INDICES, 58 INDIVIDUALS.

Index Group		Number	Percent
Leptorrhine	up to 46.9	7	12.07
Mesorrhine	47.0–50.9	26	44.83
Chamaerrhine	51.0–57.9	19	32.76
Hyperchamaerrhine	58.0 and over	6	10.34

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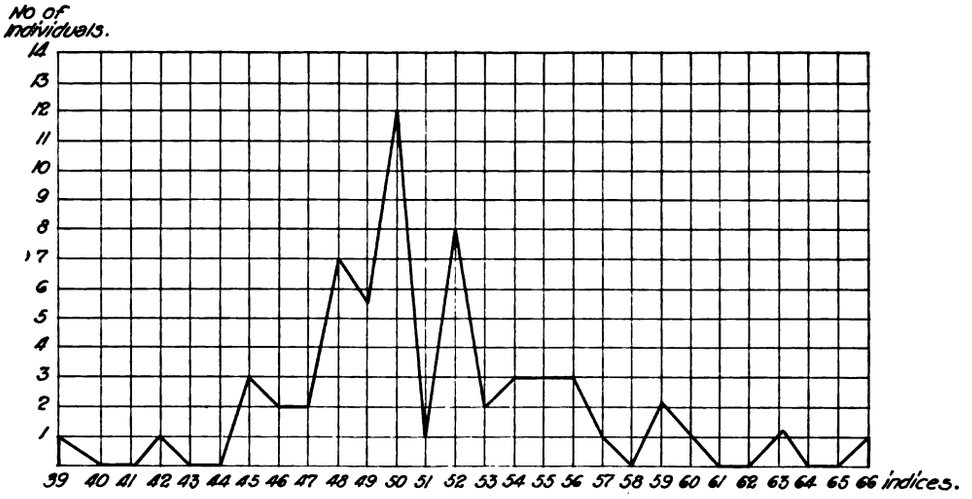
For comparison with two sets of particularly broad noses, Slav and Negro, notice the curves in figure 9.

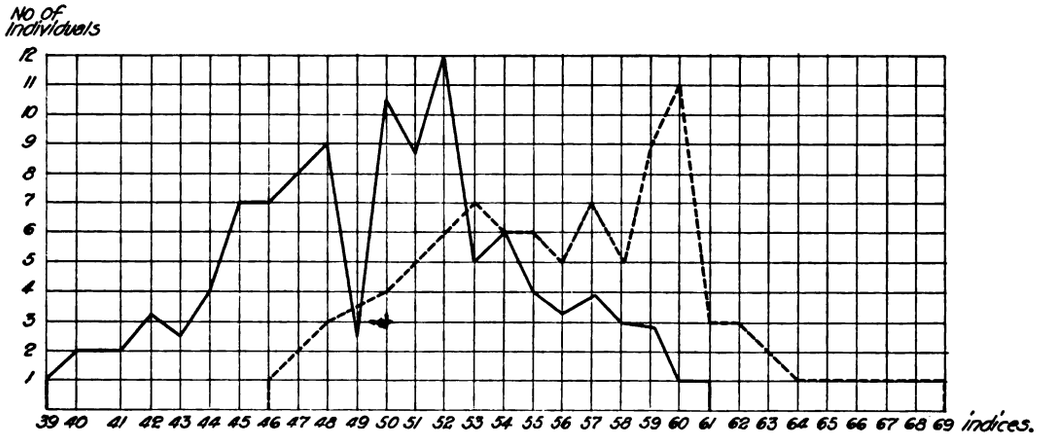
NASAL INDICES.



NEW ENGLAND INDIANS 58 SKULLS

FIG. 8

NASAL INDICES.



KAMERUNS 90 SKULLS ----

CZECHS 435 SKULLS ——

FIG. 9

ORBITAL INDEX.

The method of measuring the orbit used for this work was that of the prescriptions of the International Congress at Monaco in 1906. The orbital breadth is the distance from the fronto-maxillare, parallel to the direction of the upper and lower rims, and extending

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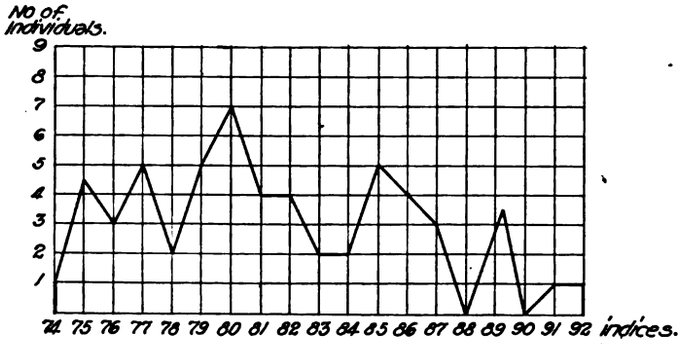
to the outermost point, the ectoconchion. The orbital height is the distance from the middle point of the lower rim, perpendicular to the orbital breadth, and extending to the upper rim. In all cases both orbits were measured, if present, and the mean used to form the index.

The orbital height in the male varies between 31-36 mm., the average is 33.83 mm.; the breadth varies between 39-47 mm., with 42.54 mm. as the average. The female orbit varies in height from 31-36.5 mm., with 33.78 mm. as the average; and in breadth from 36-43 mm., with 41.56 mm. as the average, figures 10 and 11.

ORBITAL INDICES.

MALE AND FEMALE.

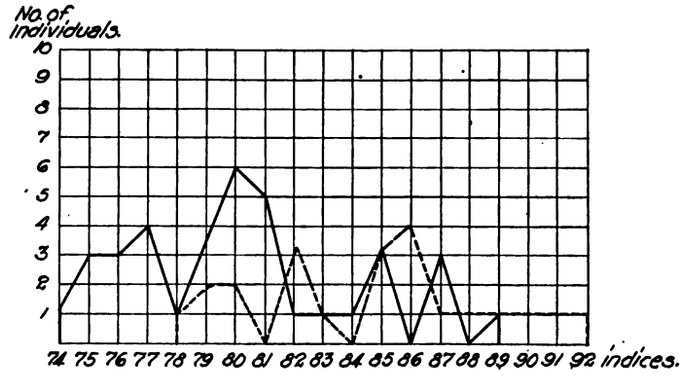


57 NEW ENGLAND INDIANS

FIG. 10

ORBITAL INDICES.

NEW ENGLAND INDIANS.



36 MALES ——

21 FEMALES ----

FIG. 11

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TABLE X.

ORBITAL INDICES.

Index Group		36 Males		21 Females	
		Number	Percent	Number	Percent
Chamaeconch	70.2–74.9	5	13.89	0	.0
Mesoconch	75.0–84.9	27	75.0	10	47.62
Hypsiconch	85.0 and over	4	11.11	11	52.38

Table X shows that there is a slight sexual difference in the size of the orbits, the orbit of the female being somewhat higher than that of the male.

MAXILLO-ALVEOLAR INDEX.

The method used to measure the length of the maxillo-alveolar border is that employed by Fischer, that is, the distance from the most anterior point of the alveolar border, between the two middle incisors, to the median point in the line tangent to the most posterior extremities of the alveolar borders. This latter point is obtained by placing a fine knitting needle in the grooves between the border and the lateral plate of the pterygoid process, and using its middle point. The breadth is the greatest transverse distance between the outer borders.

In the males, the maxillo-alveolar length varies from 46-60 mm., the average being 53.36 mm.; in the females, the length varies from 42-57 mm., the average being 51.8 mm. The breadth varies, in the males, from 53-72 mm., average, 61.39 mm.; in the females, from 44-67 mm., average, 69.62 mm.

PALATAL INDEX.

The palatal length used is the distance between the median point of the line tangent to the inner alveolar borders of the two middle upper incisors (orale) and the median point of the line tangent to the two indentations in the posterior border of the palate (Staphylion). The palatal breadth is the distance from the inner alveolar border of the second molar to the corresponding point on the opposite side.

The palatal length varies, in the male, from 43-51 mm., average, 46.11 mm.; in the female, from 37-52 mm., average 45.5 mm. The breadth varies, in the male, from 32-45 mm., average, 36.5 mm.; in the female, from 30-45 mm., average, 38.04 mm.

The palatal indices vary from 65.31 to 107.14. The following, Table XI, shows the distribution in the three usual classes. If there were two more classes given, Hyperleptostaphyline and Hyperbrachystaphyline, it would be seen that the indices would be distributed about evenly in all five classes. In other words, there seems to be no marked tendency toward a particularly broad or narrow palate in these skulls.

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TABLE XI.

PALATAL INDICES.

Index Group		36 Males		23 Females	
		Number	Percent	Number	Percent
Leptostaphyline	up to 79.9	11	30.56	9	36.13
Mesostaphyline	80.0–84.9	9	25.9	5	21.74
Brachystaphyline	85.0 and over	16	44.44	9	34.13

SAGITTAL ARCS OF THE MEDIAN SKULL BONES.

The relations between the three sagittal arcs of the frontal, parietal and occipital bones to each other and to their respective chords give the proportions and amount of curvature of the cranium.

TABLE XII.

TABLE SHOWING THE AMOUNT OF VARIATION IN THE SEPARATE ARCS.

	Female		Male	
	Extremes	Average	Extremes	Average
Frontal arc	113–137 mm.	123.0 mm.	112–142 mm.	126.2 mm.
Parietal "	101–129 mm.	119.4 mm.	101–129 mm.	122.7 mm.
Occipital "	101–137 mm.	113.3 mm.	101–147 mm.	118.8 mm.

TABLE XIII.

TABLE SHOWING THE AMOUNT OF VARIATION IN THE SEPARATE CHORDS.

	Female		Male	
	Extremes	Average	Extremes	Average
Frontal chord	102–116 mm.	108.8 mm.	104–127 mm.	113.6 mm.
Parietal "	96–117 mm.	107.2 mm.	99–121 mm.	109.6 mm.
Occipital "	89–114 mm.	96.8 mm.	85–109 mm.	97.8 mm.

Schwalbe has shown in his paper on Pithecanthropus (Ztschr. f. Morphol. u. Anthrop., Bd. 1, S. 187) that when the frontal arc is more than the parietal arc, that is, when the index, obtained by finding the value of the parietal arc in terms of the frontal as a unit, is less than 100.0%, the skull more nearly approaches the condition in the anthropoids. (See Table XIV.)

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TABLE XIV.

FRONTAL-PARIETAL RELATION IN REPRESENTATIVE PRIMATES AND RACES.

Species	Length of Frontal arc	Length of Parietal arc	Index $\frac{lp \times 100}{lf}$
Lemur mongoz	33	22	66.6
Cebus capucinus	65	27	41.5
Cynocephalus babuin	66	52	78.8
Cercopithecus sabaeus	56	43	76.7
Hylobates leuciscus	54	36	66.6
" syndactylus	72	44	61.1
Orang ad.	72	55	76.2
Troglodytes niger adult female	75	62	82.6
Pithecanthropus; point b	130	93	71.1
" " c	110	113	102.7
Average of b and c	120	103	85.8
Spy 1	115	120	104.3
Spy 2	124	120	96.7
Neanderthal	133	119	89.4
Egisheim	135	124	91.8
Chinese	130	120	92.3
Lapp	130	121	93.1
Russian	129	121	93.8
Australian	120	120	100.0
Alsatian	121	133	109.9
Dyak	116	130	112.0

After Schwalbe.

TABLE XV.

TABLE SHOWING THE RELATION BETWEEN THE PARIETAL AND FRONTAL ARCS.

Males.

	F < P		F > P		F = P	
Index Group	Number	Percent	Number	Percent	Number	Percent
Hyperdolichocephalic	4	7.41	4	7.41	1	1.85
Dolichocephalic	7	11.11	17	29.63	1	1.85
Mesocephalic	4	7.41	9	16.67	0	0
Brachycephalic	1	1.85	2	3.70	0	0
?	1	1.85	5	9.26	0	0

Females.

	F < P		F > P		F = P	
Index Group	Number	Percent	Number	Percent	Number	Percent
Hyperdolichocephalic	2	7.69	0	0	0	0
Dolichocephalic	3	11.54	6	23.08	0	0
Mesocephalic	3	11.54	7	26.92	0	0
Brachycephalic	1	3.85	4	15.38	0	0
TOTAL	26	32.50	54	67.50	2	2.50

From Table XV, it is noticeable that, of the 80 skulls measured for this point, 54 or 67.50% of them have the frontal larger than the parietal, and 26 or 32.50% have the frontal less than the parietal, while 2 or 2.50% have the two arcs equal. 68.52% of the

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females and 65.38% of the males have the frontal larger than the parietal. Schwalbe and Drontschilow are both of the opinion that the Brachycephalic forms show more Simian characteristics in this relation than the Dolichocephalic. While there are very few Brachycephalic forms among the Indians studied, it is true that the Dolichocephalic heads are less apelike in the fronto-parietal relation than the Mesocephalic. See figure 12.

The amount of bulge in these bones is shown by the relation of the arc to its chord; the higher the index, the more nearly do the two approach equality, and the less the bulge. Figure 13 shows that in the Indian the most frequent frontal index is 88; the parietal, 89; the occipital, 83. The occipital has by far the greatest protuberance of the three bones, for many of the indices run below 80. The occipital bone of the New England Indian is considerably more bulging on the whole than that of the other races with which it is compared in the curves in figure 14, the Old Egyptian, Kamerun, Telei and Czech. From Table XVI, we find that 15 of the 47 males, or 31.9%, and 6 of the 25 females, or 24%, have the occipital arc larger than the parietal; while Frizzi found 9 out of 44, or 20.45%, in his Telei. In only 8 cases out of 72 is the frontal arc less than the occipital; in all the remaining cases, it is greater.

TABLE XVI.

PARIETO-OCCIPITAL INDICES.

Arcs.

Males (47 Individuals).

	P>O		P<O		P=O	
Index Group	Number	Percent	Number	Percent	Number	Percent
Hyperdolichocephalic	7	14.89	2	4.26	0	0
Dolichocephalic	9	19.15	8	17.02	2	4.26
Mesocephalic	8	17.02	3	6.38	2	4.26
Brachycephalic	2	4.26	0	0	0	0
?	2	4.26	2	4.26	0	0
TOTAL	28	59.57	15	31.91	4	8.51

Females (25 Individuals).

	P>O		P<O		P=O	
Index Group	Number	Percent	Number	Percent	Number	Percent
Hyperdolichocephalic	2	8.0	0	0	0	0
Dolichocephalic	5	20.0	3	12.0	0	0
Mesocephalic	7	28.0	3	12.0	0	0
Brachycephalic	3	12.0	0	0	1	4.0
TOTAL	17	68.0	6	24.0	1	4.0

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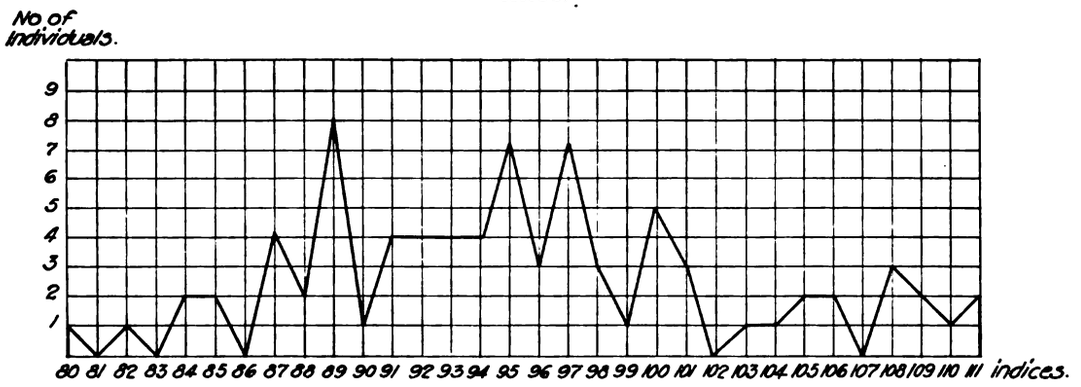
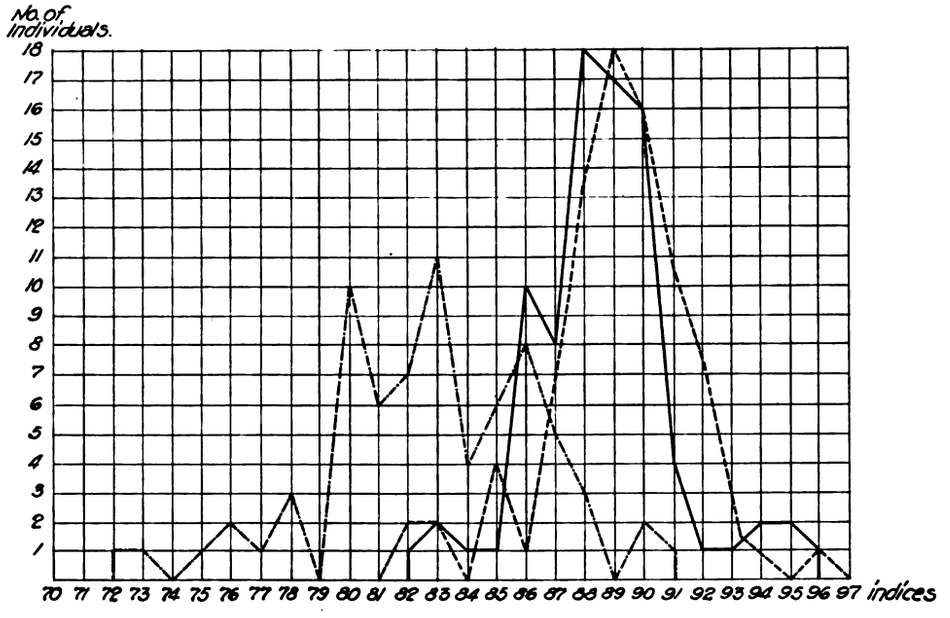
FRONTO-PARIETAL INDICES.
NEW ENGLAND INDIANS.
ARCS.



80 INDIVIDUALS

FIG. 12

RELATION OF ARC TO CHORD.
ARC TO CHORD INDICES OF FRONTAL, PARIETAL, AND OCCIPITAL BONES.



FRONTAL ARC TO CHORD INDICES ——
PARIETAL " " " ------
OCCIPITAL " " " -.-.-

FIG. 13

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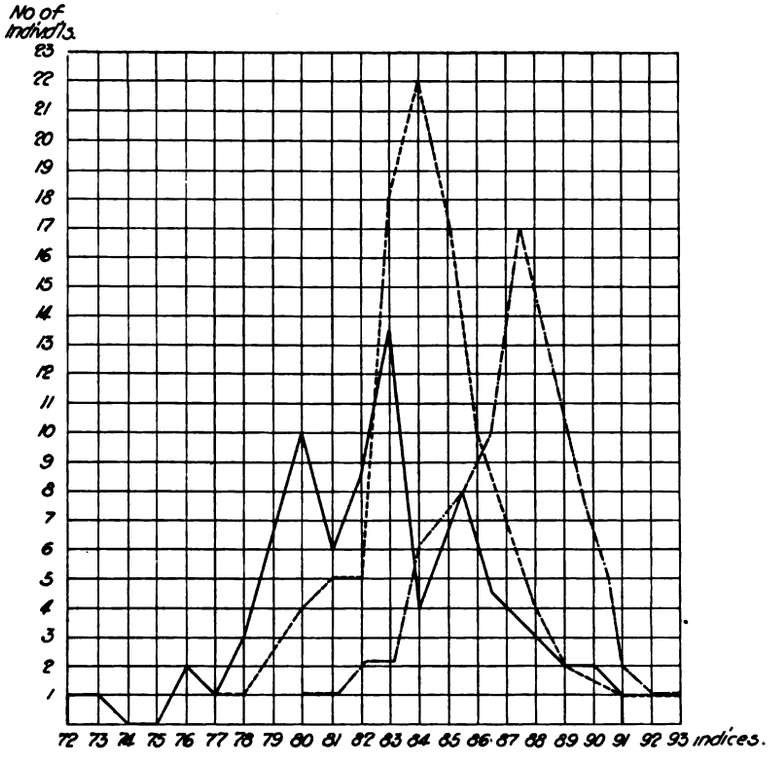
OCCIPITAL INDICES IN SEVERAL RACES.

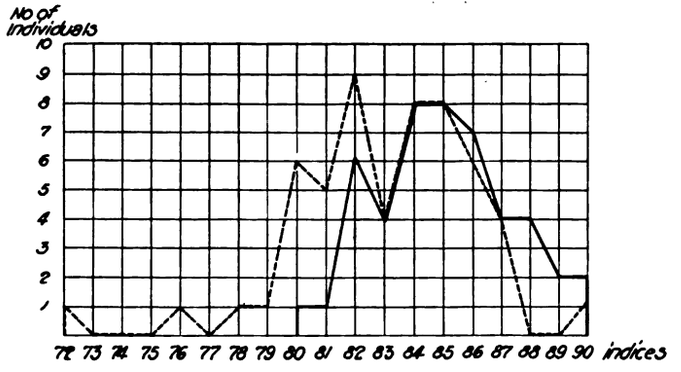
ARC TO CHORD.



OLD EGYPTIANS ------

KAMERUNS —·—·—·

NEW ENGLAND INDIANS ———



TELEI OF BOUGAINVILLE ———

CZECHS ------

FIG. 14

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TRANSVERSE MEASUREMENTS.

The following, Table XVII, gives the transverse measurements, the extremes of variation, and the mean of each one.

TABLE XVII.

TRANSVERSE MEASUREMENTS.

Measurement	Males.		Females.	
	Extremes	Mean	Extremes	Mean
Zygomatic breadth	110–147 mm.	132.2 mm.	121–135 mm.	127.3 mm.
Biauricular breadth	104–138 mm.	123.2 mm.	112–128 mm.	120.3 mm.
Intercoronal breadth	101–123 mm.	119.1 mm.	99–125 mm.	111.3 mm.
Least frontal breadth	82–108 mm.	93.2 mm.	82– 99 mm.	90.0 mm.
Inter-zygomatico maxillare	96–106 mm.	105.9 mm.	90–106 mm.	99.3 mm.
Interlacrimal breadth	18– 27 mm.	23.6 mm.	92–104 mm.	22.8 mm.
Inter-frontomalare temporale	92–104 mm.	98.0 mm.	85–100 mm.	93.0 mm.
Greatest cranial breadth	120–151 mm.	136.2 mm.	126–141 mm.	133.6 mm.
Biasterial breadth	96–124 mm.	107.8 mm.	97–111 mm.	107.1 mm.
Bimastoid breadth	90–124 mm.	105.5 mm.	88–106 mm.	99.4 mm.

From these measurements, Table XVII, a number of indices may be computed in order to show the relation of these breadths to each other.

FRONTO-BIORBITAL INDEX.

The fronto-biorbital index is the index obtained by using the inter-frontomalare temporal breadth as a unit and expressing the value of the least frontal breadth in terms of this unit. This index has a range from 80.53 to 96.84.

TRANSVERSE FRONTAL INDEX.

The transverse frontal index is obtained by expressing the value of the least frontal breadth in terms of the greatest frontal breadth, the intercoronal. This index varies, in the male, from 73.17 to 89.91; in the female, from 76.0 to 87.88. It shows the degree of lateral arching of the frontals, and would be caused by more or less development of the frontal lobes of the brain.

FRONTO-MALAR INDEX.

The fronto-malar index expresses the relation of the least frontal breadth in terms of the bizygomatic breadth. The extremes of variation of this index are 64.49 and 76.23. The curve in figure 15 is not very smooth but is sufficient to show that the mode would be at either 67 or 68 if a larger number of indices could have been plotted. The Kameruns having a much broader face, show, in the curve, figure 16, that the mode is at 75.

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FRONTO-JUGAL INDEX.

NEW ENGLAND INDIANS.

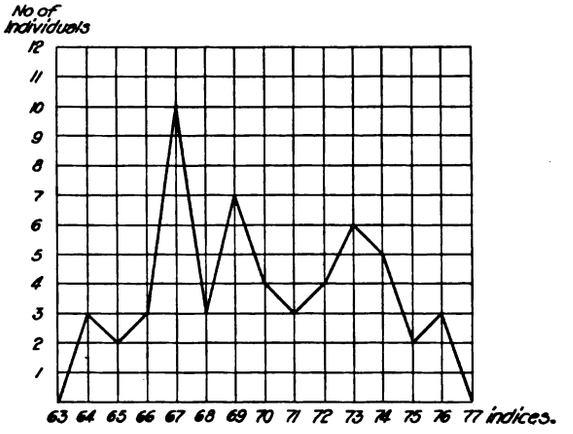

FIG. 15

FRONTO-JUGAL INDEX.

91 KAMERUNS.

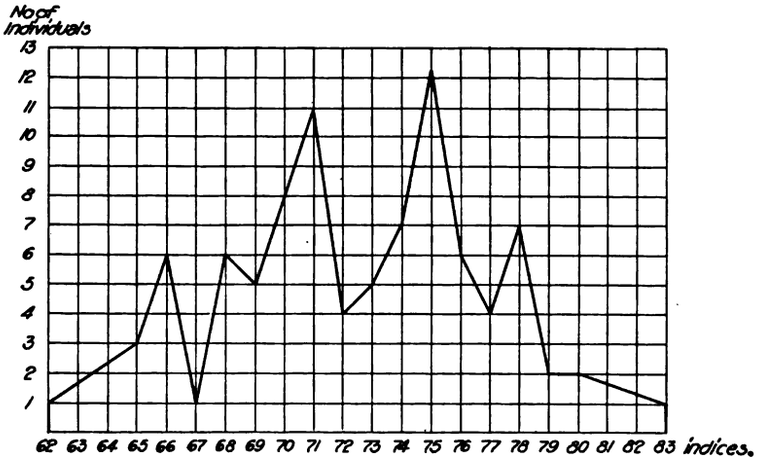

FIG. 16

CRANIO–FACIAL INDEX.

The cranio-facial index expresses the relation of the bizygomatic breadth to the greatest cranial breadth in terms of the latter. This index signifies a prevalence of cranial rather than facial development. The extremes of variation of this index are 85.71 and 109.02. The mode of the frequency curve, figure 17, is at 97, but the indices are not heavily massed at the mode, thus making a more attenuated curve. The frequency curve of the cranio-facial indices of the Kameruns given in figure 18 shows a mode at 96 and two smaller ones at 99 and 102.

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CRANIO-FACIAL INDEX.

55 NEW ENGLAND INDIANS.

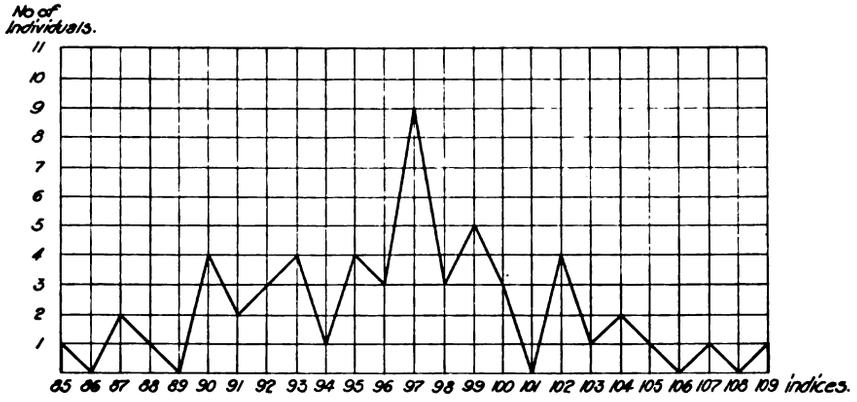

FIG. 17

CRANIO-FACIAL INDEX.

76 KAMERUNS.

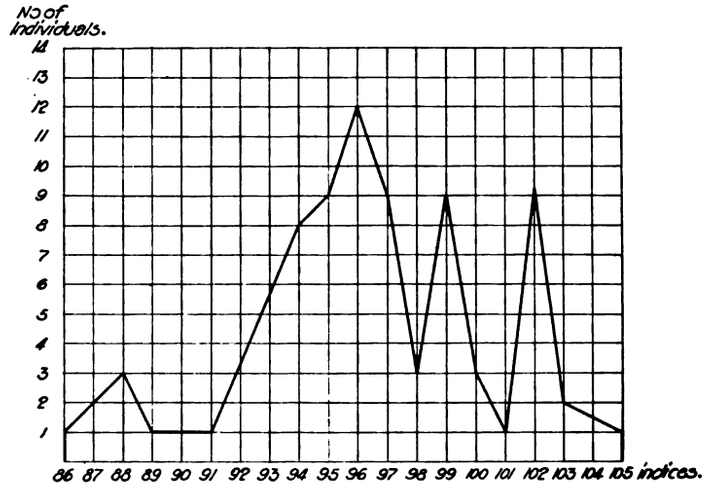

FIG. 18

TRANSVERSE FRONTO-PARIETAL INDEX.

The transverse fronto-parietal index expresses the relation of the least frontal breadth and the greatest cranial breadth in terms of the latter. The extremes of variation of this index are 60.54 and 78.26.

TOTAL SAGITTAL ARC.

The total sagittal arc, from nasion to opisthion, Table XVIII, varies from 336-398 mm. in the male, with the majority lying between 360 mm. and 380 mm.; that of the female varies between 330-383 mm., with the majority between 350 mm. and 370 mm.

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TABLE XVIII.

TOTAL SAGITTAL ARC.

Male		Female	
Total Arc	Number	Total Arc	Number
330–340 mm.	1	330–340 mm.	4
340–350 mm.	2	340–350 mm.	1
350–360 mm.	6	350–360 mm.	11
360–370 mm.	15	360–370 mm.	4
370–380 mm.	13	370–380 mm.	4
380–390 mm.	5	380–390 mm.	1
390–400 mm.	3		

TRANSVERSE ARC.

The transverse arc, from porion to porion, perpendicular to the Frankfort Horizontal, Table XIX, varies in the male from 301-370 mm., the majority lying between 310 mm. and 340 mm. The females vary between 270-337 mm., with the majority between 300 mm. and 330 mm.

TABLE XIX.

TRANSVERSE ARC FROM PORION TO PORION.

Male		Female	
Transverse Arc	Number	Transverse Arc	Number
270–280 mm.	1	300–310 mm.	5
280–290 mm.	0	310–320 mm.	14
290–300 mm.	4	320–330 mm.	11
300–310 mm.	6	330–340 mm.	9
310–320 mm.	8	340–350 mm.	3
320–330 mm.	5	350–360 mm.	2
330–340 mm.	2	360–370 mm.	0
340–350 mm.	1	370–380 mm.	1

HORIZONTAL ARC. No. 1.

The horizontal arc, taken over the glabella and opisthocranium, Table XX, varies in the male from 495-555 mm., the majority lying between 500 mm. and 530 mm. The female shows a variation between 461-532 mm., the majority lying between 480 mm. and 510 mm.

TABLE XX.

HORIZONTAL ARC OVER THE GLABELLA.

Males		Females	
Horizontal Arc	Number	Horizontal Arc	Number
490–500 mm.	2	460–470 mm.	1
500–510 mm.	11	470–480 mm.	0
510–520 mm.	12	480–490 mm.	6
520–530 mm.	8	490–500 mm.	7
530–540 mm.	3	500–510 mm.	3
540–550 mm.	3	510–520 mm.	4
550–560 mm.	2	520–530 mm.	1
		530–540 mm.	1

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HORIZONTAL ARC. No. 2.

The horizontal arc over the ophryon, Table XXI, shows a variation in the male between 490-546 mm., with the majority between 490 mm. and 520 mm. In the female, the variation lies between 458-523 mm., the majority being between 480 mm. and 500 mm.

TABLE XXI.

HORIZONTAL ARC OVER THE OPHRYON.

Male		Female	
Horizontal Arc	Number	Horizontal Arc	Number
490–500 mm.	10	450–460 mm.	1
500–510 mm.	9	460–470 mm.	0
510–520 mm.	10	470–480 mm.	3
520–530 mm.	4	480–490 mm.	9
530–540 mm.	3	490–500 mm.	6
540–550 mm.	3	500–510 mm.	1
550–560 mm.	0	510–520 mm.	3
		520–530 mm.	1

OCCIPITAL FORAMEN.

The length of the occipital foramen varies, in the male, from 32-42 mm., the average being 36 mm.; in the female, from 32-40 mm., average 36.25 mm. The breadth varies, in the male, from 22-35 mm.; in the female, from 22-33 mm.; the averages being 30.72 mm. and 30.76 mm. respectively.

OCCIPITAL FORAMEN.

56 NEW ENGLAND INDIANS.

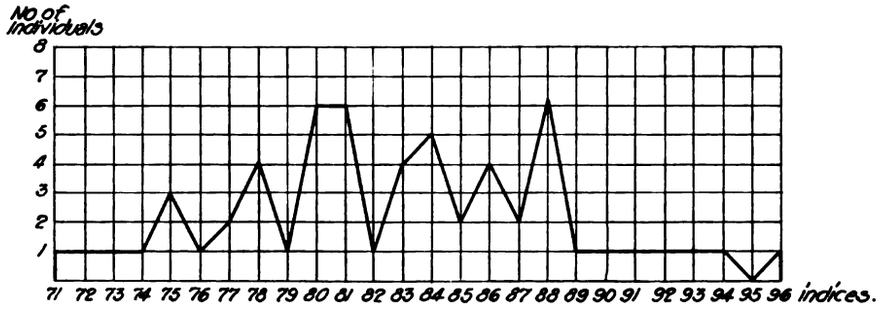

FIG. 19

From the curve in figure 19, it will be seen that the majority of the indices indicate an elliptical shape but not a very narrow one, for they more nearly approach 100 than 50 and the former indicates the index for a circle.

If it is fair to judge from so few specimens, the females have a larger number which more nearly approach the circle than the males.

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MANDIBLE.

Only forty-five mandibles were available for measurement and many of these were fragmentary. The following, Tables XXII and XXIII, are the measurements taken and their ranges of variation.

TABLE XXII.

MEASUREMENTS ON THE MANDIBLE.

Males.	
Measurement	Range of Variation
Condylar breadth (20)	84–138 mm.
Bi-gonial breadth (26)	80–116 mm.
Breadth of ramus (30)	29– 41 mm.
Height of ramus (25)	51– 74 mm.
Chin height (29)	31– 39 mm.

TABLE XXIII.

MEASUREMENTS ON THE MANDIBLE.

Females.	
Measurement	Range of Variation
Condylar breadth (14)	102–124 mm.
Bi-gonial breadth (14)	87–104 mm.
Breadth of ramus (14)	28– 39 mm.
Height of ramus (14)	44– 66 mm.
Chin height (14)	28– 38 mm.

RELATION OF BASAL FACIAL TO BASAL CRANIAL LENGTH.

The basal facial length (ba-pr) varies, in the male, from 89 mm. to 111 mm.; in the female, from 84 mm. to 104 mm.; the basal cranial length (ba-n), in the male, from 92 mm. to 115 mm.; in the female, from 89 mm. to 129 mm. In most cases this cranial length is greater than the facial, but in the case of 18.18% of the females and 9.09% of the males the relation is reversed. In one male and one female, the two lengths are equal.

When compared with each other, these basal lengths show the degree of prognathism of the skull. If a comparison is made with the Kameruns (Drontschilow) where the prognathism is rather marked, 71.6% have the basal facial length greater than the basal cranial length. Thus, it is evident that, in the case of the New England Indians, the prognathism is slight.

CRANIAL CAPACITY.

The measurement of the cranial capacity was made, whenever the skull was complete, by the mustard seed method described by Hrdlička in Science, June 26, 1903. With the skulls which were not measured at the Peabody Museum I used a graduated tube made by Eimer and Amend instead of the one made by Ranke. The Eimer and Amend tube has been found to register 20 cc. to 22 cc. higher than the Ranke. A control skull was measured before the real one was attempted.

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Of the 17 males measured, the capacity varied from 1255 cc. to 1650 cc., average, 1404.4 cc.; of the 18 females measured, the extremes ranged from 1100 cc. to 1600 cc., the average, 1287.5 cc.

TABLE XXIV.

CRANIAL CAPACITY.

NEW ENGLAND INDIANS.

Males			Females		
Museum	Number	Capacity	Museum	Number	Capacity
Smith	100 c	1450 cc.	Peabody	2	1165 cc.
Park	B.	1400 cc.	"	2596	1600 cc.
Andover	41763	1370 cc.	"	2597	1360 cc.
Warren	25	1460 cc.	"	2598	1320 cc.
Peabody	43	1650 cc.	"	10.231	1225 cc.
"	10.229	1255 cc.	"	18.881	1320 cc.
"	10.246	1260 cc.	"	33.434	1510 cc.
"	11.249	1435 cc.	"	33.435	1300 cc.
"	25.299	1509 cc.	"	47.948	1155 cc.
"	47.946	1310 cc.	"	47.949	1500 cc.
"	58.796	1520 cc.	"	48.019	1270 cc.
Gilbert Coll.	1141	1260 cc.	Gilbert Coll.	1383	1170 cc.
"	1395	1380 cc.	"	2230	1290 cc.
"	1628	1415 cc.	"	2355	1270 cc.
"	1629	1400 cc.	"	2363	1300 cc.
"	2367	1300 cc.	"	2366	1100 cc.
"	2369	1440 cc.	"	2417	1280 cc.
"	2817	1280 cc.	"	2818	1240 cc.

PROJECTION MEASUREMENTS.

Whenever possible, the skull was clamped into a "Kubus Kraniophor" adjusted to the Frankfort horizontal; and a tracing of the sagittal curve made by the use of a Lissauer diagraph (made by P. Hermann, Zürich). The median points on this curve, opisthion, inion, lambda, bregma, nasion, prosthion, basion, were carefully marked by pricking the paper under the lead of the diagraph pencil at these points.

The calvarial height, the length of the perpendicular from the nasion-inion line to the highest point on the curve, varies, in the male, from 98 mm. to 115 mm.; in the female, from 101 mm. to 114 mm.

Schwalbe used at first the glabella-inion as the base upon which to erect the calvarial height but the nasion-inion is now considered more practical, as in many cases, especially in female skulls, the glabella is not noticeably projecting.

The amount of curvature of the frontal bone, which is correlated with a greater or less development of the frontal lobes of the brain, can be accurately measured by the size of the angle whose apex is on the frontal arc, at the base of the perpendicular from the frontal chord to the highest point of the arc, and whose arms pass through nasion and bregma. As the value of the angle approaches 180° the frontal arc approaches its chord, thus signifying a less development of the frontal lobes; conversely as the value of the angle approaches 90°, the size of the frontal arc increases, thus denoting a greater development of the frontal lobes and presumably a higher state of mental growth.

This frontal curvature angle varies, in the male, from 127° to 144°; in the female, from 122° to 138°. The females show on the whole a tendency toward a smaller angle than the males.

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In the same way, the occipital angle shows the amount of curvature of the occipital bone and the development of the occipital lobes of the brain. (The occipital lobes include the general areas for vision.)

The occipital bone has a characteristically large protuberance in these skulls. The size of the angle varies, in the male, from 97° to 126°; in the female, from 112° to 129°.

The amount of prognathism may be determined by the comparison of the angle formed by the intersection of the lines, nasion-prosthion and basion-prosthion.

This angle (ba. pr. n.) varies, in the male, from 65° to 80°; in the female, from 70° to 86°; the majority in both sexes are very near 70°.

The value of the angle formed by the intersection of the lines opisthion-basion and prosthion-basion gives the amount of inclination of the occipital foramen, which in its turn is correlated with the relation of the head to the vertebral column. As is shown by the diagrams on Plate VII, the inclination of the occipital foramen, in the chimpanzee and in modern man, is reversed when taken in relation to the line prosthion-opisthion, while that of the prehistoric skull of La Chapelle aux Saintes is about half way between the two. As the value of the angle approaches 18° the condition is probably more nearly primitive than when the value approaches 90°. In order to make a comparison, the specimens were divided into two classes, those with an angle greater than 165°, Plate IX, and those with one less than 165°, Plate X. Of the males, 40.91% have an angle greater than 165°; of the females, 41.18%. The smallest angle of all the specimens examined (which was only 39) was that of a female and measured 138.5°, Plate VIII.

CONCLUSIONS.

As a result of these measurements, I can state that a typical cranium of the Southern New England Indian might have the following measurements since these are the average measurements of male and female taken separately.

TABLE XXV.

TABLE OF AVERAGE MEASUREMENTS.

	Male	Female
Name of Measurement	Average measurements	Average measurements
Greatest length	182.2 mm.	175.5 mm.
Glabella-inion length	175.5 mm.	164.4 mm.
Nasion-inion length	171.0 mm.	160.3 mm.
Frontal arc	126.2 mm.	123.0 mm.
Parietal arc	122.7 mm.	119.4 mm.
Occipital arc	118.8 mm.	113.3 mm.
Frontal chord	113.6 mm.	108.8 mm.
Parietal chord	109.6 mm.	107.2 mm.
Occipital chord	97.8 mm.	96.8 mm.
Total facial length	113.58 mm.	111.9 mm.
Superior facial length	69.2 mm.	67.3 mm.
Orbital height	33.83 mm.	33.7 mm.
Nasal height	50.35 mm.	49.40 mm.
Chin height	34.1 mm.	32.5 mm.
Least frontal breadth	93.2 mm.	90.0 mm.
Inter-frontomalare temporale	98.0 mm.	93.0 mm.
Inter-frontomalare orbitale	98.05 mm.	93.0 mm.

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Name of Measurement	Male: Average measurements	Female: Average measurements
Inter-zygomaxillare	105.9 mm.	99.3 mm.
Inter-lacrimale	23.6 mm.	22.8 mm.
Orbital breadth from maxillo-frontale	42.52 mm.	41.5 mm.
Nasal breadth	25.77 mm.	25.3 mm.
Zygomatic breadth	132.0 mm.	127.6 mm.
Auricular breadth	123.2 mm.	120.3 mm.
Inter-coronal breadth	119.1 mm.	111.3 mm.
Greatest cranial breadth	134.0 mm.	132.0 mm.
Horizontal circumference over glabella	518.1 mm.	497.0 mm.
" " " ophryon	511.1 mm.	492.5 mm.
Transverse circumference	324.6 mm.	312.6 mm.
Basal cranial length	105.7 mm.	102.7 mm.
Cranial height	136.1 mm.	133.2 mm.
Basal facial length	102.3 mm.	97.3 mm.
Basion-gnathion	114.1 mm.	110.5 mm.
Basion-opisthion	36.0 mm.	36.5 mm.
Breadth of occipital foramen	30.7 mm.	30.76 mm.
Total sagittal arc	368.7 mm.	357.0 mm.
Inter-asterial breadth	107.8 mm.	107.1 mm.
Inter-mastoid breadth	105.5 mm.	99.4 mm.
Maxillo-alveolar length	53.36 mm.	51.8 mm.
" breadth	61.39 mm.	69.62 mm.
Palatal length	46.11 mm.	45.5 mm.
" breadth	36.5 mm.	38.0 mm.
Auricular height	115.4 mm.	113.5 mm.
Condylar breadth	115.5 mm.	113.2 mm.
Inter-gonial	93.5 mm.	98.0 mm.
Height of ramus	58.7 mm.	55.0 mm.
Breadth of ramus	35.5 mm.	33.8 mm.

Name of Index	Male: Average Indices	Female: Average Indices
Length-breadth	73.63	75.43
Length-height	74.73	75.9
Breadth-height	101.49	100.76
Auricular length-height	63.19	65.14
Transverse frontal	78.15	81.08
Transverse frontal-parietal	69.40	68.18
Sagittal fronto-parietal	97.62	96.75
Sagittal frontal	90.48	88.62
Sagittal parietal	89.43	89.92
Sagittal occipital	82.35	85.84
Total facial	85.61	87.50
Superior facial	52.27	52.34
Nasal	52.0	51.02
Orbital	80.95	80.49
Inter-orbital	23.47	24.70
Maxillo-alveolar	115.09	134.62
Palatal	78.26	84.44
Cranio-facial	98.51	96.97
Fronto-biorbital	94.90	96.77
Fronto-malar	70.45	70.31
Malar-mandibular	70.45	76.56
Fronto-parietal chord	95.61	98.17

The hypothetical typical male is, then, dolicho-, orthocephalic, mesoprosopic, chamaerrhine, mesoconch, leptostaphyline. The female is meso-, hypsicephalic, mesoprosopic, chamaerrhine, mesoconch, mesostaphyline.

Smith College Anthropological Laboratory.
May 15, 1914.

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APPENDIX A.

DESCRIPTION OF MEASUREMENTS.

The measurements for this work were taken according to the prescriptions of the International Conference at Monaco in 1906. Those not described in that report were used according to the directions of Prof. Otto Schlaginhaufen, Zürich, and Prof. Eugen Fischer, Freiburg.

The instruments used are the craniometer, goniometer, and slide-compass made by the firm P. Herman, Zürich.

1. g-oe. Greatest cranial length: this is measured from the most projecting part of the glabella to the most protruding point of the occipital bone, in a median plane. Craniometer.

2. g-i. Glabella-inion length: the distance between the most prominent part of the glabella and the inion, the point of junction of the superior curved lines; or, if these are too indistinct, the external point corresponding to the point of the internal occipital protuberance [Broca]. Craniometer.

3. n-i. Nasion-inion length: the distance from the nasion to the inion. Craniometer.

4. arc n-b. Frontal arc: the curve of the frontal bone from the nasion to the bregma. Measuring tape.

5. arc g-i. Glabella-inion arc: the curve from glabella to inion. Measuring tape.

6. arc b-l. Parietal arc: the curve of the parietal bone from the bregma to the lambda. Measuring tape.

7. n-b. Frontal chord: the distance between the nasion and the bregma. Slide-compass.

8. b-l. Parietal chord: the distance between bregma and lambda. Slide-compass.

9. n-gn. Total facial length: the distance from nasion to gnathion, the median and most downwardly projecting point on the lower rim of the mandible. Slide-compass.

10. n-pr. Superior facial length: the distance from nasion to prosthion, the most projecting median point on the alveolar border of the upper jaw, generally between the two middle incisors. Slide-compass.

11. orb. ht. Orbital height: the distance from the middle point of the lower orbital rim, perpendicular to the orbital breadth, to the upper rim. Slide-compass.

12. n-ns. Nasal height: the distance from nasion to naso-spinale, i. e., the intersection of the median sagittal plane and the line tangent to the deepest points of the piriform aperture. Slide-compass.

13. id-gn. Chin height: the distance between the infradentale, the most projecting median point of the alveolar border of the mandible between the two middle incisors, and the gnathion. Slide-compass.

14. ft-ft. Least frontal breadth: the least breadth between the temporal lines on the frontal bone, the terminal points being the fronto-temporalia. Slide-compass.

15. fmt-fmt. Outer orbito-facial breadth: the distance between the most lateral lying point on the zygomatico-frontal suture [frontomalare-temporale] on one side, to the corresponding point on the other side. Slide-compass.

16. fmo-fmo. Inner orbito-facial breadth: the distance between the point on the orbital rim where the zygomatico-frontal suture cuts it [frontomalare-orbitale] on one side to the corresponding point on the other side. Slide-compass.

17. zm-zm. Breadth of upper jaw: the distance between the two zygomatico-maxillaria, the lowest points on the zygomatico-maxillary sutures.

18. la-la. Posterior interorbital breadth: the breadth between the two lacrimalia. This latter is the point where the posterior rim of the lacrimal groove meets the frontal-lacrimal suture. Slide-compass.

19. mf-mf. Anterior interorbital breadth: the distance between the two maxillofrontalia, the points on the inner rims cut by the fronto-maxillary sutures. Slide-compass.

20. mf-ek. Orbital breadth from the maxillofrontale: the distance from the maxillofrontale, parallel to the direction of the upper and lower rim, and extending to the outermost point of the orbit, the ectoconchion. Slide-compass.

21. d-ek. Orbital breadth from the dacryon: the distance from the dacryon, the point where frontal, maxillary, and lacrimal bones meet, to the ectoconchion as in the above. Slide-compass.

22. la-ek. Orbital breadth from the lacrimale: the distance from the lacrimale to ectoconchion as in the above. Slide-compass.

23. na.br. Nasal breadth: the greatest breadth of the piriform aperture. Slide-compass.

24. zy-zy. Zygomatic breadth: the greatest breadth between the two most lateral points on the zygomatic arches. The arms of the craniometer are applied to each arch and then moved back and forth until the greatest breadth is registered. Craniometer.

25. au-au. Biauricular breadth: the distance from the point on the zygomatic arch directly above the auditory meatus, on one side to the corresponding point on the other side. Craniometer.

26. co-co. Greatest frontal breadth: the distance from the most lateral point on the coronal suture [coronale] to the corresponding point on the opposite side. Craniometer.

27. eu-eu. Greatest cranial breadth: the greatest breadth perpendicular to the median sagittal plane but not above the temporal lines of the parietal bones. Craniometer.

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28. circ(g). Horizontal arc over the glabella: the circumference over the most prominent part of the glabella and the most projecting part of the posterior portion of the cranium. Measuring tape.

29. circ(on). Horizontal circumference over the ophryon: the circumference over the ophryon, the point of intersection of the least frontal breadth line and the median sagittal plane, and the opisthocranium as in the above. Measuring tape.

30. circ(po-po). Transverse arc: the arc from the porion, the point on the rim of the auditory meatus directly above its center, over the bregma to the corresponding point on the opposite side. Measuring tape.

31. n-ba. Basal facial length: the distance from nasion to basion, the middle point on the anterior rim of the occipital foramen. Craniometer.

32. ba-b. Cranial height: the distance from basion to bregma. Craniometer.

33. cran. ht. Total cranial height: the distance from basion to the highest point on the skull in a plane perpendicular to the Frankfort horizontal and passing through the basion. Goniometer.

34. ba-pr. Facial length: from basion to prosthion. Craniometer.

35. ba-gn. Basion-gnathion length: from basion to gnathion. Craniometer.

36. ba-o. Length of the occipital foramen: the distance from basion to opisthion. Slide-compass.

37. max. br. Breadth of occipital foramen: the maximum breadth of the occipital foramen, perpendicular to the length line. Slide-compass.

38. l-o. Occipital chord: the distance between the points lambda and opisthion. Slide-compass.

39. arc l-o. Occipital arc: the arc from lambda to opisthion. Measuring tape.

40. arc n-o. Total sagittal arc: the circumference from nasion to opisthion. Measuring tape.

41. ast-ast. Occipital breadth: the distance between the two points at the junction of the three sutures, parieto-mastoid, parieto-occipital, and occipito-mastoid, on each side of the occipital bone, asterion. Slide-compass.

42. ms-ms. Mastoid breadth: the distance between the points of the two mastoids. Slide-compass.

43. mx. alv. lg. Maxillo-alveolar length: the distance from the most anterior point of the alveolar border, between the two middle incisors, to the median point of the line tangent to the most posterior extremity of the alveolar border, which may be obtained by placing a fine knitting needle in the grooves between the border and the lateral plate of the pterygoid process. Slide-compass.

44. mx. alv. br. Maxillo-alveolar breadth: the distance between the outer alveolar borders which spans the greatest distance. Slide-compass.

45. pal. lg. Palatal length: the distance between the median point of the line tangent to the inner alveolar border of the two middle incisors and the median point of the line tangent to the two indentations in the posterior border of the palate. Slide-compass.

46. pal. br. Palatal breadth: the distance from the inner alveolar border of the second molar to the corresponding point on the opposite side. Slide-compass.

47. aur. ht. Auricular height: the perpendicular distance between two planes parallel to the Frankfort Horizontal; one, passing through the poria, the other, tangent to the top of the cranium at the median point located by the intersection of the sagittal curve and a plane perpendicular to the Frankfort Horizontal and passing through the poria.

48. go-go. Bigonial breadth: the distance between the gonion, the point on the angle of the lower jaw which is directed most downwards, outwards, and backwards, on one side to the corresponding point on the other side. Slide-compass.

49. ht. ramus. Height of ramus: from gonion to top of condyle. Slide-compass.

50. condylar br. of mand. Condylar breadth of mandible: the distance between the two outermost points on the condyles. Slide-compass.

51. br. ramus. Breadth of ramus: the least breadth of the ramus between the anterior and posterior borders. Slide-compass.

52. ang. n. pr. Total profile angle: the angle which the nasion-prosthion line makes with the Frankfort Horizontal line. Goniometer.

53. ang. n. ss. Nasal profile angle: the angle made by the Frankfort Horizontal and the line between nasion and subspinale. This latter point is the median point where the lower anterior border of the anterior nasal spine runs into the alveolar process. Goniometer.

54. ang. ss. pr. Alveolar profile angle: the angle formed by the line between the subspinale and prosthion and the Frankfort Horizontal. Goniometer.

55. arc pars cereb. Arc of the pars cerebralis: the portion of the frontal arc from ophryon to bregma. Measuring tape.

56. arc pars(g). Arc of the pars glabellaris: the portion of the frontal arc from nasion to ophryon. Measuring tape.

57. cran. cap. Cranial capacity: the number of cubic centimeters in the cranial cavity, measured by the use of mustard seed, as described by Hrdlicka in Science, June 26, 1903. In measuring the skulls which were not from the Peabody Museum a graduated tube made by Eimer and Amend was used instead of the Ranke tube. It has been found that the graduated cylinder made by Eimer and Amend registers 20 cc. to 22 cc. higher than the Ranke. A control skull was measured each time before attempting the specimen.

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APPENDIX B.

GEOGRAPHICAL DISTRIBUTION OF CRANIA.

I. CONNECTICUT RIVER VALLEY.

a. *Massachusetts.*

Peabody	32560	Longmeadow
"	32563	"
"	32564	"
"	32565	"
"	37924	"
Amherst	2230	Easthampton
"	2363	"
"	2365	"
"	2366	"
"	2367	"
"	2817	Hadley
"	2818	"
"	2917	"
Smith	105 a	"
"	158	"
"	102	North Hadley
"	100 c	"
Amherst	1395	"
Smith	104	Hatfield
"	123	"
Amherst	1383	Deerfield
"	1630	"
"	2369	"
"	2356	Turners Falls
"	2355	Springfield
Holyoke		Smiths Ferry

b. *Connecticut.*

Amherst	1628	Farmington
"	1628	"

II. MASSACHUSETTS; SEABOARD.

Peabody	43	Newburyport
"	10.237	Marblehead
"	10.246	"
"	10.266	Salem
"	10.249	"
"	10.250	"
"	24.851	"
"	10.229	Saugus
"	10.230	"
"	10.231	"
"	18.881	Beverley
"	57.384	"
"	660	"
Andover	36092	Ipswich
Peabody	11.249	West Andover
"	48.008	"
Andover	38897	Lawrence
"	38937	Brighton
Peabody	45.647	Winthrop
"	45.648	"
"	45.649	"
Peabody	15.378	Revere
"	25.299	"
"	58.796	Cambridge
"	47.948	West Newton
"	47.949	"
Amherst	2417	Swansea
Peabody	18.225	Swampscott
"	2	Hingham
"	37.920	Plymouth
"	37.921	"
"	33.431	Marion
"	33.434	"
"	33.435	"
"	26.132	Kingston
"	26.133	"

III. MASSACHUSETTS; INLAND (*not Connecticut River Valley*).

Peabody	47.951	Wayland
"	57.385	Winchendon

IV. RHODE ISLAND, EAST OF NARRAGANSETT BAY. (*Wampanoag.*)

Peabody	15.306	Cumberland
"	15.307	"
"	15.308	"
"	25.96	Tiverton
"	25.97	"
"	25.98	"
Park Museum	E 1019	"
"	E 908	Warren
"	E 909	"
"	E 910	"
Warren	25	"
Charles Carr	11a	"
"	11b	"
"	11c	"
"	11d	"
"	11e-f	"

V. RHODE ISLAND, WEST OF NARRAGANSETT BAY. (*Narragansett, Niantic.*)

Peabody	41.763	Jamestown
"	24.77	Westerly
Park Museum	A	No data
"	B	"

VI. MASSACHUSETTS.

No other data.

Peabody	15.310
"	48.019
"	10.271
"	10.272
"	57.383

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APPENDIX C.

GENERAL DESCRIPTION OF CRANIA.

GILBERT COLLECTION, AMHERST COLLEGE.

1141, male; length-breadth index 77.84, dolicho-, hypsicephalic, mesoprosopic, chamaerrhine, mesoconch, leptostaphyline.

1383, female; length-breadth index 80.24, brachycephalic, hypsicephalic, chamaeprosopic, hyperchamaerrhine, mesoconch, brachystaphyline.

1395, male; length-breadth index 74.32, dolicho-, hypsicephalic, chamaerrhine, mesoconch, brachystaphyline.

1628, male; length-breadth index 74.74, dolicho-, orthocephalic, mesoprosopic, mesorrhine, mesoconch, brachystaphyline.

1629, male; length-breadth index 72.73, dolicho-, orthocephalic, mesoprosopic, mesorrhine, mesoconch, mesostaphyline.

1630, male; length-breadth index 77.05, meso-, orthocephalic, hyperchamaeprosopic, mesorrhine, hypsiconch, —.

2230, female; length-breadth index 69.15, hyperdolicho-, chamaecephalic, —, —, —, —.

2355, female; length-breadth index 74.32, dolicho-, chamaecephalic, —, chamaerrhine, hypsiconch, brachystaphyline.

2356, male; length-breadth index 73.89, dolicho-, hypsicephalic, mesoprosopic, chamaerrhine, mesoconch, brachystaphyline.

2363, female; length-breadth index 74.16, dolicho-, chamaecephalic, —, —, —, —.

2365, male; length-breadth index —, orthocephalic, —, hyperchamaerrhine, hypsiconch, leptostaphyline.

2366, female; length-breadth index 83.54, brachy-, hypsicephalic, mesoprosopic, mesorrhine, hypsiconch, leptostaphyline.

2367, male; length-breadth index 80.11, brachy-, hypsicephalic, —, mesorrhine, hypsiconch, brachystaphyline.

2369, male; length-breadth index 73.94, dolicho-, orthocephalic, mesoprosopic, hyperchamaerrhine, mesoconch, mesostaphyline.

2417, female; length-breadth index 76.97, meso-, hypsicephalic, mesoprosopic, hyperchamaerrhine, hypsiconch, brachystaphyline.

2818, female; length-breadth index 73.03, dolicho-, orthocephalic, mesoprosopic, chamaerrhine, mesoconch, mesostaphyline.

2946, male; length-breadth index 67.68, hyperdolicho-, chamaecephalic, —, chamaerrhine, mesoconch, brachystaphyline.

PEABODY MUSEUM, CAMBRIDGE.

2, female; length-breadth index 72.99, dolicho-, orthocephalic, leptoprosopic, mesorrhine, hypsiconch, leptostaphyline.

43, male; length-breadth index 73.98, dolicho-, orthocephalic, —, mesorrhine, mesoconch, brachystaphyline.

660, female; lengh-breadth index 67.02, hyperdolicho-, chamaecephalic, mesoprosopic, leptorrhine, mesoconch, leptostaphyline.

24.77, male; —, —, —, hyperchamaeprosopic, mesorrhine, mesoconch, brachystaphyline.

25.96, female; length-breadth index 78.77, meso-, hypsicephalic, chamaeprosopic, chamaerrhine, mesoconch, mesostaphyline.

25.97, female; length-breadth index 78.95, meso-, hypsicephalic, mesoprosopic, mesorrhine, hypsiconch, brachystaphyline.

25.98, female; length-breadth index 77.33, meso-, hypsicephalic, leptoprosopic, mesorrhine, hypsiconch, mesostaphyline.

10.229, male; length-breadth index 71.21, dolicho-, hypsicephalic, mesoprosopic, chamaerrhine, mesoconch, mesostaphyline.

10.230, male; length-breadth index 73.26, dolicho-, orthocephalic, mesoprosopic, mesorrhine, mesoconch, leptostaphyline.

10.231, female; length-breadth index 77.19, meso-, hypsicephalic, leptoprosopic, leptorrhine, hypsiconch, leptostaphyline.

10.237, male; length-breadth index 72.43, —, —, —, —, —, —.

10.246, male; length-breadth index 77.22, meso-, orthocephalic, hyperchamaeprosopic, chamaerrhine, mesoconch, brachystaphyline.

10.249, male; length-breadth index 69.23, hyperdolicho-, orthocephalic, leptoprosopic, mesorrhine, mesoconch, leptostaphyline.

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10.250 (posterior part of cranium).
10.266, female (frontal bone).
10.271, female (frontal bone).
10.272, female (fragments).
11.249, male; length-breadth index 70.74, dolicho-, orthocephalic, mesoprosopic, mesorrhine, chamaeconch, mesostaphyline.
15.306, male; length-breadth index 80.32, brachy-, chamaecephalic, mesoprosopic, leptorrhine, mesoconch, brachystaphyline.
15.307, male; length-breadth index 75, meso-, hypsicephalic, chamaeprosopic, chamaerrhine, mesoconch, brachystaphyline.
15.308, male; length-breadth index 74.44, dolicho-, orthocephalic, mesoprosopic, chamaerrhine, mesoconch, leptostaphyline.
15.310, male; length-breadth index 76.54, meso-, orthocephalic, leptoprosopic, leptorrhine, mesoconch, leptostaphyline.
15.378, female; length-breadth index 72.63 dolicho-, hypsicephalic, mesoprosopic, mesorrhine, mesoconch, brachystaphyline.
18.225, male; length-breadth index 69.23, hyperdolicho-, orthocephalic, mesoprosopic, mesorrhine, hypsiconch, mesostaphyline.
18.881, female; length-breadth index 71.67, dolicho-, orthocephalic, mesoprosopic, leptorrhine, mesoconch, mesostaphyline.
24.851, male; length-breadth index 69.23, hyperdolicho-, chamaecephalic, —, —, —, —.
25.299, male; length-breadth index 73.30, dolicho-, orthocephalic, mesoprosopic, mesorrhine, mesoconch, brachystaphyline.
26.132, male; length-breadth index 78.89, meso-, hypsicephalic, mesoprosopic, mesorrhine, mesoconch, mesostaphyline.
26.133, female; length-breadth index 84.24, brachycephalic, —, chamaeprosopic, chamaerrhine, hypsiconch, mesostaphyline.
32.560, male (fragments).
32.563, male; length-breadth index 72.11, dolichocephalic, —, —, —, —, —.
32.564, male; length-breadth index 75.82, mesocephalic, —, —, —, —, —.
32.565, male; length-breadth index 74.87, dolichocephalic, —, —, —, —, —.
33.431, female (fragments).
33.434, female; length-breadth index 74.05, dolicho-, hypsicephalic, leptoprosopic, chamaerrhine, mesoconch, leptostaphyline.
33.435, female; length-breadth index 78.61, meso-, hypsicephalic, mesoprosopic, mesorrhine, mesoconch, brachystaphyline.
37.920 (fragments).
37.921 (fragments).
37.924, female; length-breadth index 76.47, meso-, orthocephalic, —, —, —, —.
38.937, female; length-breadth index 71.26, dolicho-, orthocephalic, —, chamaerrhine, hypsiconch, brachystaphyline.
45.647, male; length-breadth index 63.49, hyperdolicho-, orthocephalic, hyperleptoprosopic, mesorrhine, chamaeconch, leptostaphyline.
45.648, male; length-breadth index 71.82, dolichocephalic, chamaeprosopic, mesorrhine, mesoconch, mesostaphyline.
45.649, male; length-breadth index 77.53, meso-, hypsicephalic, —, —, —, —.
47.946, male; length-breadth index 81.50, brachy-, hypsicephalic, leptoprosopic, leptorrhine, mesoconch, mesostaphyline.
47.948, female; length-breadth index 79.04, meso-, hypsicephalic, —, —, —, —.
47.949, female; length-breadth index 79.67, meso-, orthocephalic, hyperchamaeprosopic, chamaerrhine, chamaeconch, brachystaphyline.
47.951, female (fragments).
48.008, male (fragments).
48.019, female; length-breadth index 75.88, meso-, hypsicephalic, leptoprosopic, chamaerrhine, hypsiconch, leptostaphyline.
57.383, male; length-breadth index 75.96, mesocephalic, —, —, —, —, —.
57.384, male; length-breadth index 75.15, mesocephalic, hypsicephalic, —, —, —, —.
57.385, female (fragments).
58.796, male; length-breadth index 73.80, dolicho-, orthocephalic, mesoprosopic, leptorrhine, mesoconch, mesostaphyline.

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Smith College Collection.

100 c, male; length-breadth index 73.22, dolicho-, orthocephalic, chamaeprosopic, chamaerrhine, chamaeconch, brachystaphyline.

104, male; length-breadth index 74.46, dolichocephalic, —, —, —, —.

105, male; length-breadth index 75.82, meso-, orthocephalic, mesoprosopic, chamaerrhine, mesoconch, brachystaphyline.

123, female (fragments).

158, male; length-breadth index 73.80, dolicho-, orthocephalic, —, —, —, —.

Park Museum, Providence.

A, female; length-breadth index 75.84, meso-, hypsicephalic, chamaeprosopic, mesorrhine, mesoconch, brachystaphyline.

B, male; length-breadth index 79.21, meso-, hypsicephalic, leptoprosopic, mesorrhine, chamaeconch, brachystaphyline.

E 908, male; length-breadth index 74.30, dolicho-, hypsicephalic, chamaeprosopic, mesorrhine, leptostaphyline.

E 909, male; length-breadth index 69.68, hyperdolicho-, orthocephalic, hyperleptoprosopic, chamaerrhine, mesoconch, leptostaphyline.

E 910, female; length-breadth index 81.55, brachy-, hypsicephalic, mesoprosopic, chamaerrhine, hypsiconch, leptostaphyline.

E 1019, female; length-breadth index 73.99, dolichocephalic, hypsicephalic, —, mesorrhine, hypsiconch, leptostaphyline.

Phillips Academy Collection, Andover.

36092, female; length-breadth index 70.2, dolicho-, orthocephalic, —, —, —.

38897, male?; length-breadth index 69.8, hyperdolichocephalic, hypsicephalic, —, —, —, —.

41763, male; length-breadth index 68.3, hyperdolicho-, orthocephalic, —, —, —, —.

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—, male; length-breadth index 68.51, hyperdolichocephalic, —, mesoprosopic, mesorrhine, mesoconch, brachystaphyline.

Warren, R. I.

25, male; length-breadth index 75.54, meso-, hypsicephalic, chamaeprosopic, chamaerrhine, chamaeconch, brachystaphyline.

11a, ?; length-breadth index 72.88 (fragments).

11b, ?; length-breadth index 75.66 (fragments).

11c, male; length-breadth index 73.9 (fragments).

11d, e, f (fragments).

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Plate I.

GILBERT COLLECTION, AMHERST COLLEGE. 1395.

Length-Breadth Index 74.32.

This is a male skull obtained by C. M. Lamson from North Hadley in 1863. The preservation is not very good on the left side due to the fact that locally the Indians were buried lying on the right side, thus leaving the left exposed. The teeth have fallen out since death.

The following are the measurements of this skull:

Greatest length	183 mm.	Zygomatic breadth	— mm.
Glabella-inion	177 mm.	Auricular breadth	124 mm.
Nasion-inion	173 mm.	Intercoronal breadth	114 mm.
Frontal arc	128 mm.	Greatest cranial breadth	136 mm.
" chord	114 mm.	Horizontal circumference over the glabella	515 mm.
Parietal arc	122 mm.	Horizontal circumference over the ophryon	510 mm.
" chord	109 mm.	Transverse circumference	310? mm.
Occipital arc	115 mm.	Nasion-basion	105 mm.
" chord	96 mm.	Basion-bregma	142 mm.
Total sagittal arc	362 mm.	Cranial height	143 mm.
Nasion-gnathion	116 mm.	Basion-prosthion	98 mm.
Nasion-prosthion	72 mm.	Basion-gnathion	111 mm.
Orbital height	32.5 mm.	Basion-opisthion	37 mm.
Nasion-nasospinale	46 mm.	Breadth of foramen	29 mm.
Chin height	37 mm.	Bi-asterial breadth	106 mm.
Least frontal breadth	90.5 mm.	Bi-mastoid breadth	101.5 mm.
Inter-frontomalare temporale	113 mm.	Maxillo-alveolar length	52 mm.
Inter-frontomalare orbitale	103 mm.	" " breadth	62 mm.
Inter-zygomaxillare	— mm.	Palatal length	43 mm.
Inter-lacrimal	22.5 mm.	" breadth	41 mm.
Inter-maxillofrontal	20 mm.	Auricular height	115 mm.
Orbital breadth from the maxillofrontal	42 mm.	Condylar breadth	— mm.
Orbital breadth from the dacryon	41 mm.	Bi-gonial	96 mm.
Orbital breadth from the lacrimale	39 mm.	Height of ramus	56 mm.
Nasal breadth	26 mm.	Breadth of ramus	31 mm.
		Cranial capacity	1380 cc.

The following are the indices derived from these measurements:

Length-breadth	74.32	Superior facial	—
Length-height	77.60	Nasal	52.17
Breadth-height	104.31	Orbital	77.38
Auricular length-height	66.12	Inter-orbital	22.33
Calvarial height	58.96	Maxillo-alveolar	119.23
Transverse frontal	77.82	Palatal	95.35
Transverse fronto-parietal	66.91	Cranio-facial	—
Sagittal fronto-parietal	95.31	Fronto-biorbital	80.53
" frontal	89.06	Fronto-malar	—
" parietal	89.36	Malar-mandibular	—
" occipital	83.48	Fronto-parietal chord	95.61
Total facial	—		

General Description of Skull.

Male, circ. 35 yrs., dolicho-, chamaecephalic, chamaerrhine, chamaeconch, brachystaphyline.

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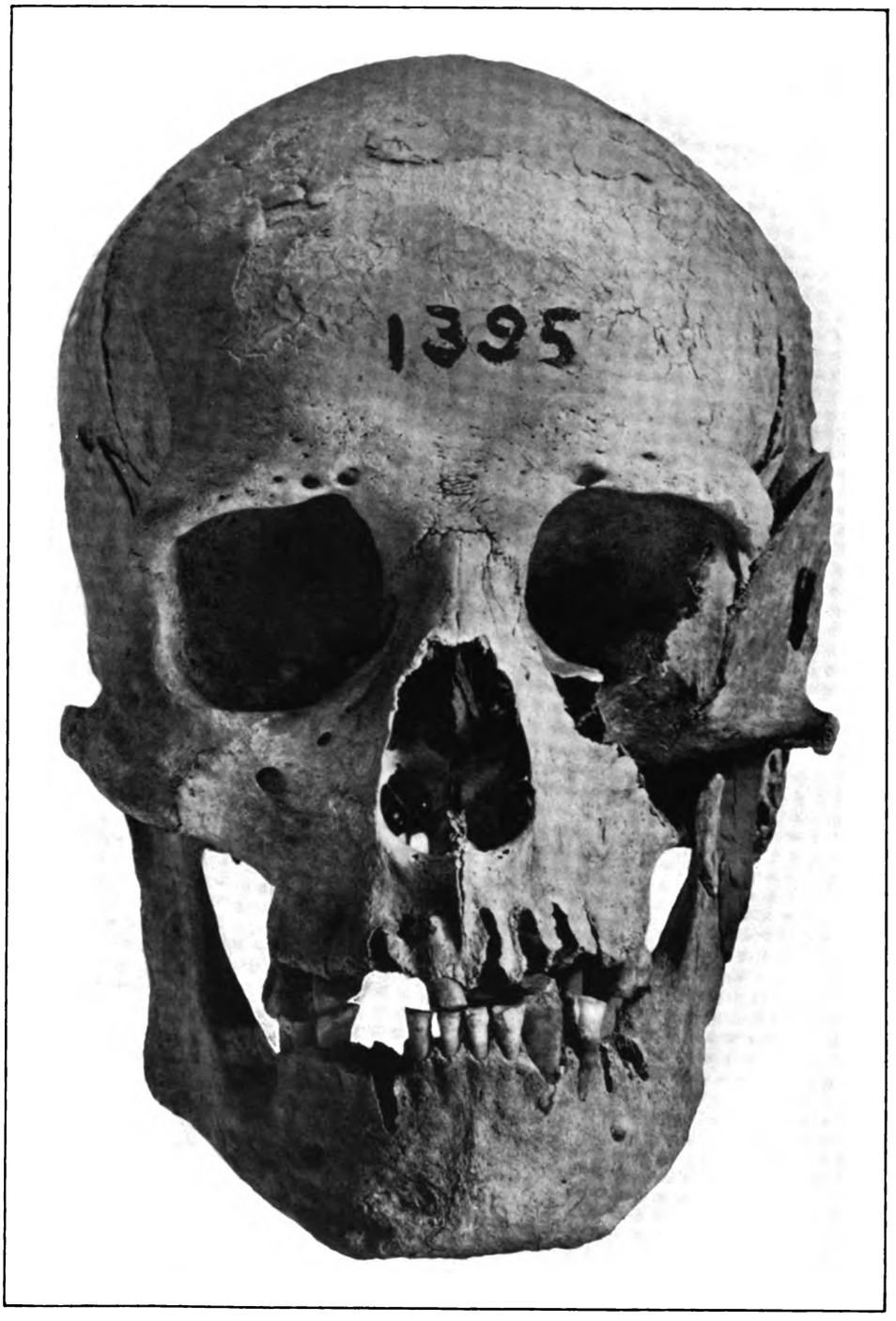

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Plates II and III.

SMITH COLLEGE COLLECTION. 100 c.

Length-breadth Index 73.22.

This is the skull of a young man found in L. P. Bullard's tobacco field, North Hadley, Mass., in October, 1904. H. H. Wilder published an account of this excavation in The American Anthropologist (N. S.), Vol. VII, No. 2, 1905. The preservation is good; all the teeth are present, but there is a hole in the left maxillary and malar bone and the right zygomatic arch is broken.

The following are the measurements of this cranium:

Greatest length	183 mm.	Zygomatic breadth	137+mm.
Glabella-inion length	172 mm.	Auricular breadth	130 mm.
Nasion-inion length	168 mm.	Intercoronal breadth	110 mm.
Frontal arc	119 mm.	Greatest cranial breadth	134 mm.
" chord	109 mm.	Horizontal circumference over the glabella	515 mm.
Parietal arc	120 mm.	Horizontal circumference over the ophryon	510 mm.
" chord	109 mm.	Transverse circumference	306 mm.
Occipital arc	119 mm.	Nasion-basion	103 mm.
" chord	96 mm.	Basion-bregma	129 mm.
Total sagittal arc	356 mm.	Cranial height	132 mm.
Nasion-gnathion	110 mm.	Basion prosthion	98 mm.
Nasion-prosthion	64 mm.	Basion-gnathion	114 mm.
Orbital height	34 mm.	Basion-opisthion	39 mm.
Nasion-nasospinale	47 mm.	Breadth of foramen	29 mm.
Chin height	34 mm.	Bi-asterial breadth	109 mm.
Least frontal breadth	89 mm.	Bi-mastoid breadth	105 mm.
Inter-frontomalare temporale	110 mm.	Maxillo-alveolar length	51 mm.
Inter-frontomalare orbitale	103 mm.	Maxillo-alveolar breadth	60 mm.
Inter-zygomaxillare	106 mm.	Palatal length	50 mm.
Inter-lacrimal	26 mm.	Palatal breadth	45 mm.
Inter-maxillofrontal	25 mm.	Auricular height	116 mm.
Orbital breadth from the maxillofrontal	45 mm.	Condylar breadth	124? mm.
Orbital breadth from the dacryon	41 mm.	Bi-gonial breadth	98 mm.
Orbital breadth from the lacrimale	38 mm.	Height of ramus	55 mm.
Nasal breadth	26 mm.	Breadth of ramus	34 mm.
		Cranial capacity	1450.5 cc.

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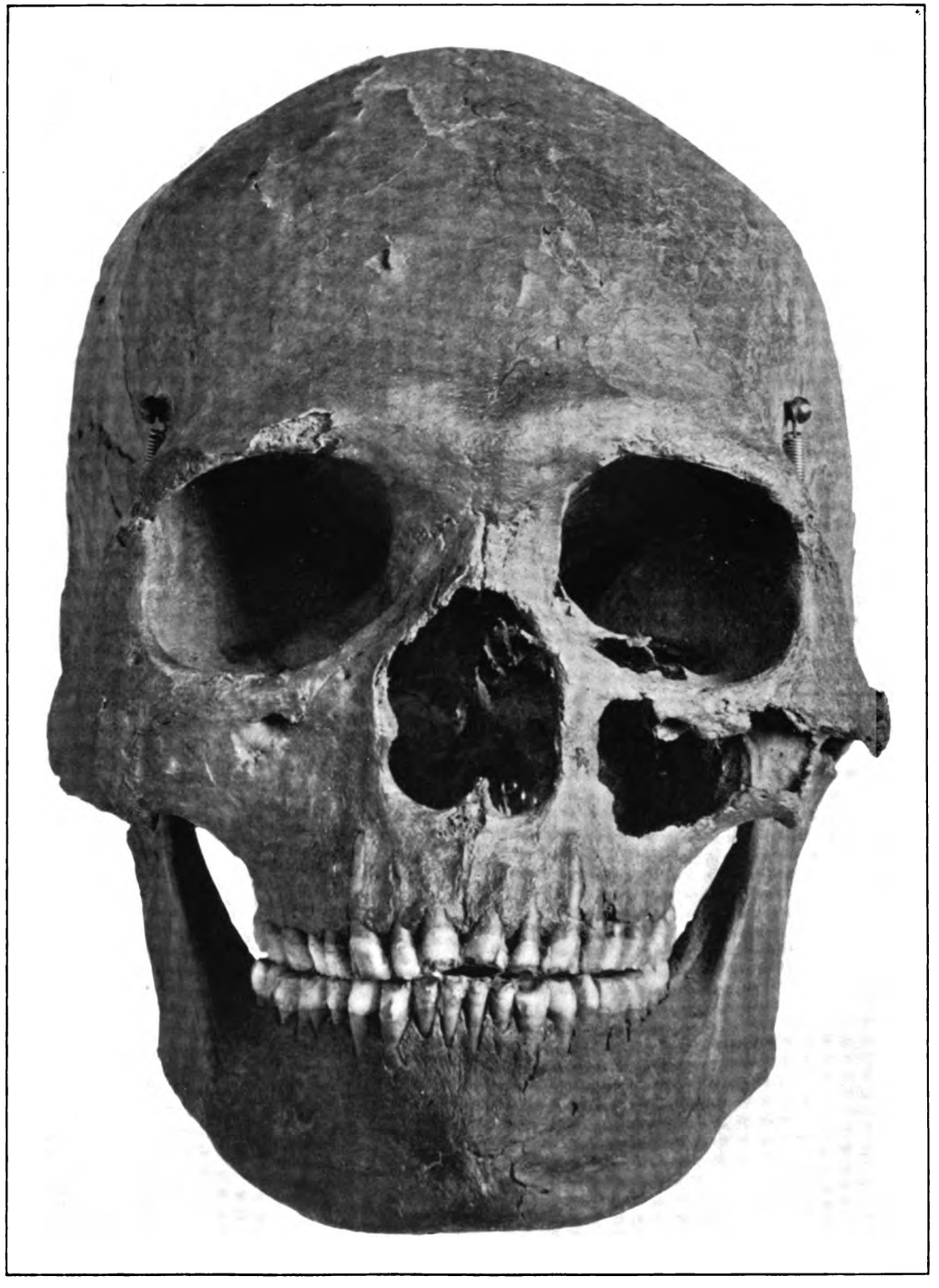

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Plates II and III.

The following are the indices derived from these measurements:

Length-breadth index	73.22	Total facial	80.29
Length-height "	70.49	Superior facial	46.71
Breadth-height "	96.27	Nasal	55.32
Auricular length-height	63.39	Orbital	75.56
Calvarial height	63.69	Inter-orbital	25.24
Transverse frontal	78.76	Maxillo-alveolar	117.65
Transverse fronto-parietal	66.42	Palatal	90.0
Sagittal fronto-parietal	100.84	Cranio-facial	102.24
" frontal	91.60	Fronto-biorbital	80.91
" parietal	89.17	Fronto-malar	64.96
" occipital	80.67	Malar-mandibular	71.83

General Description of Skull.

Male, circ. 25 yrs., dolicho-, hypsicephalic, chamaeprosopic, chamaeconch, chamaerrhine, brachystaphyline.

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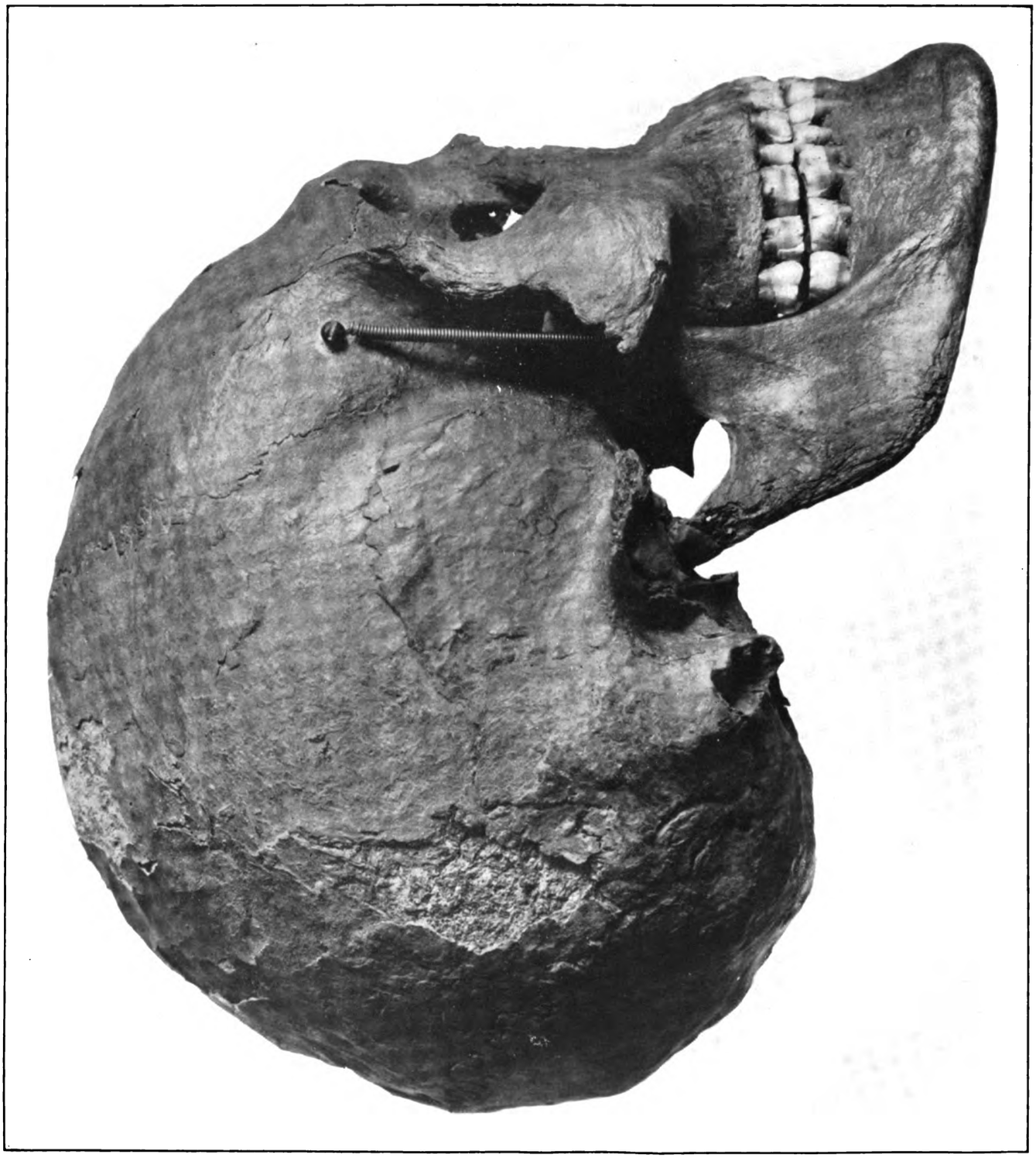

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Plates IV and V.

GILBERT COLLECTION, AMHERST COLLEGE. 2946.

Length-Breadth Index 67.68.

This is a male skull from Old Hadley. "Two Indian skeletons dug up from the Indian Burial Ground at Fort Hill in the south part of the town of Old Hadley. Excavated by Dr. Edw. Hitchcock in 1904." This was a twin grave. This skeleton is also figured in the American Anthropologist (N. S.), Vol. VII, No. 2, 1905. The alveolar rim on the right side is shrunken from loss of teeth during life.

The following are the measurements of this skull:

Greatest length	198	mm.	Zygomatic breadth	—	mm.
Glabella-inion	196	mm.	Auricular breadth	128	mm.
Nasion-inion	194	mm.	Intercoronal breadth	113	mm.
Frontal arc	140	mm.	Greatest cranial breadth	134	mm.
" chord	123	mm.	Horizontal circumference over the glabella	555	mm.
Parietal arc	115?	mm.	Horizontal circumference over the ophryon	537	mm.
" chord	102	mm.	Transverse circumference	312	mm.
Occipital arc	147	mm.	Nasion-basion	103	mm.
" chord	106	mm.	Basion-bregma	133	mm.
Total sagittal arc	398	mm.	Cranial height	133	mm.
Nasion-gnathion	118	mm.	Basion-prosthion	102	mm.
Nasion-prosthion	68	mm.	Basion-gnathion	117	mm.
Orbital height	34	mm.	Basion-opisthion	37	mm.
Nasion-nasospinale	50	mm.	Breadth of foramen	30	mm.
Chin height	33	mm.	Bi-asterial breadth	88	mm.
Least frontal breadth	97	mm.	Bi-mastoid breadth	117?	mm.
Inter-frontomalare temporale	109	mm.	Maxillo-alveolar length	57	mm.
Inter-frontomalare orbitale	99	mm.	" " breadth	58	mm.
Inter-zygomaxillare	99	mm.	Palatal length	48	mm.
Inter-lacrimale	22	mm.	" breadth	42	mm.
Inter-maxillofrontal	18	mm.	Auricular height	114	mm.
Orbital breadth from the maxillofrontal	43	mm.	Condylar breadth	—	mm.
Orbital breadth from the dacryon	39	mm.	Bi-gonial breadth	—	mm.
Orbital breadth from the lacrimale	38	mm.	Height of ramus	60	mm.
Nasal breadth	26	mm.	Breadth of ramus	34	mm.
			Cranial capacity	—	cc.

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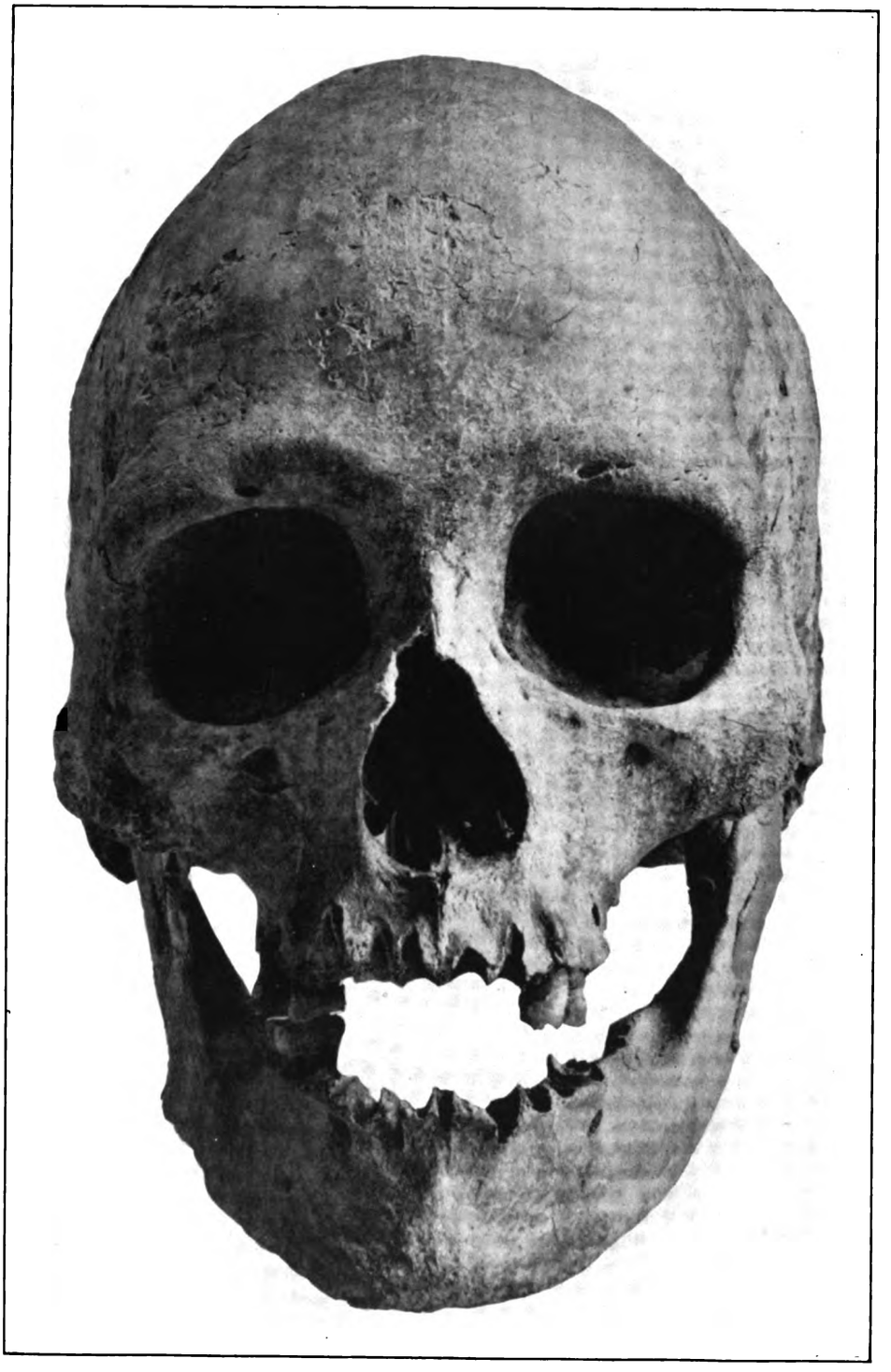

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Plates IV and V.

The following are the indices derived from these measurements.

Length-breadth	67.68	Superior facial	—
Length-height	67.17	Nasal	52.00
Breadth-height	99.17	Orbital	79.07
Auricular length-height	58.08	Inter-orbital	22.22
Calvarial height	53.61	Maxillo-alveolar	101.75
Transverse frontal	85.84	Palatal	87.50
Transverse fronto-parietal	72.39	Cranio-facial	—
Sagittal fronto-parietal	82.14	Fronto-biorbital	88.99
" frontal	87.86	Fronto-malar	—
" parietal	88.70	Malar-mandibular	—
" occipital	72.11	Fronto-parietal chord	82.93
Total facial	—		

General Description of Skull.

Male, circ. 40 yrs., hyperdolicho-, hypsicephalic, chamaerrhine, chamaeconch, brachystaphyline.

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PLATE V.

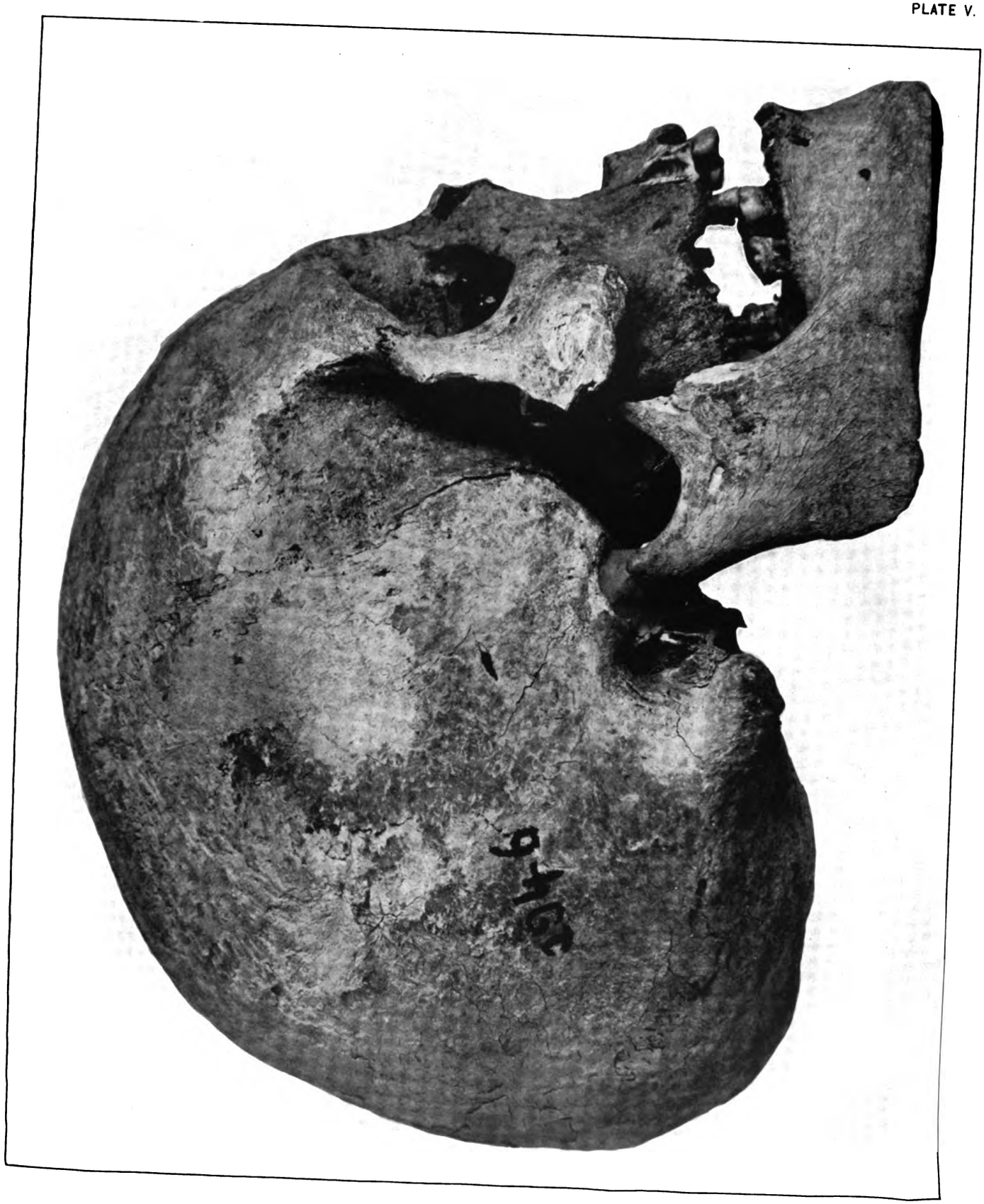

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Plate VI.

WARREN, RHODE ISLAND.

Length-Breadth Index 75.54 No. 25.

This is the top view (norma verticalis) of a skull from Warren, Rhode Island. It is known, from the associated objects found in the graves, that this is one of the Wampanoags of the trade period from 1615 to 1675.

The following are the measurements which can be seen in this view:

Greatest cranial length	184	mm.	Zygomatic breadth	140	mm.
Frontal arc	133	mm.	Auricular breadth	132	mm.
" chord	114	mm.	Intercoronal breadth	114	mm.
Parietal arc	125	mm.	Greatest cranial breadth	139	mm.
" chord	111	mm.	Bi-asterial breadth	114	mm.
Least frontal breadth	94	mm.	Bi-mastoid breadth	118	mm.

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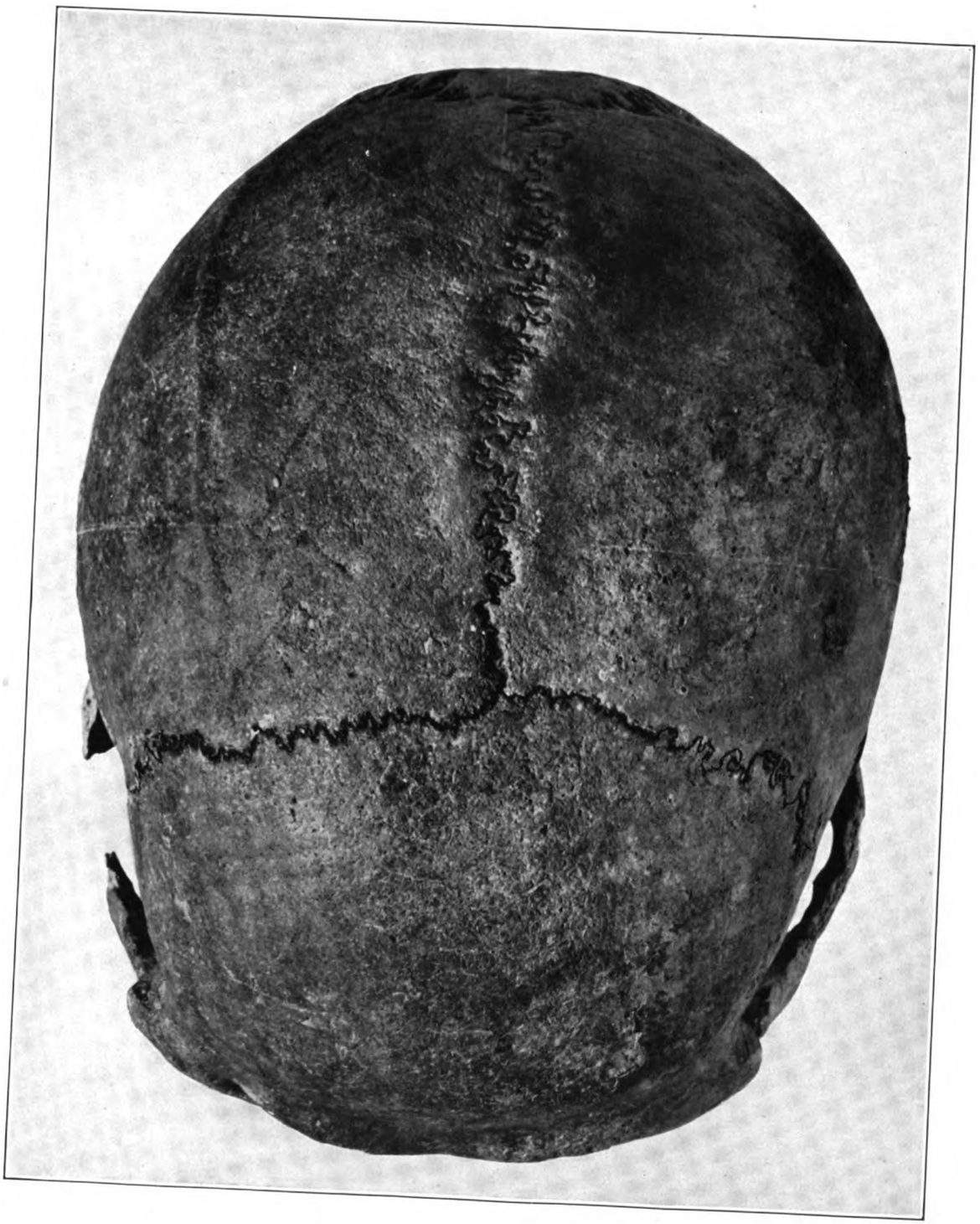
PLATE VI.



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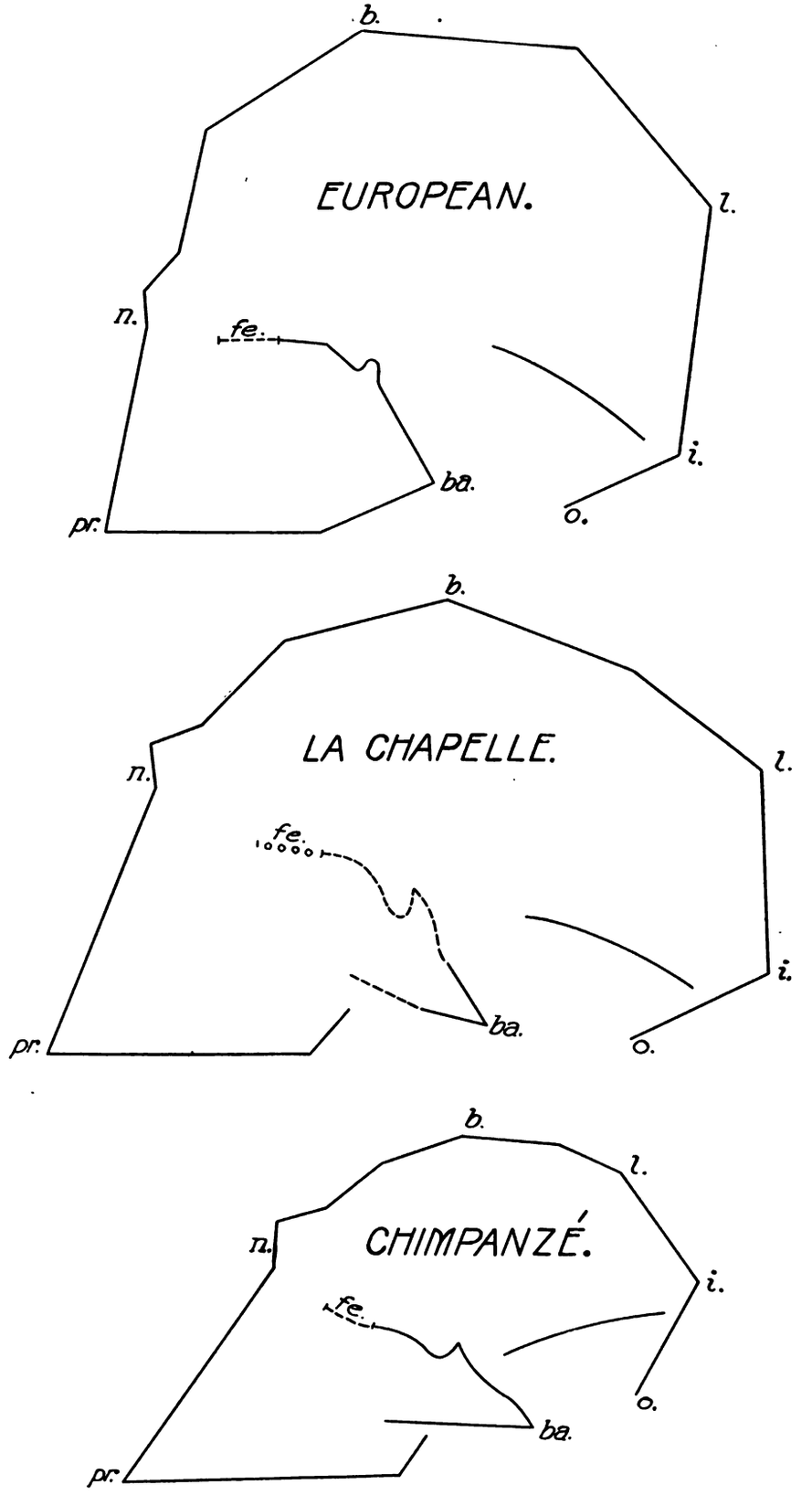

Schematic diagrams of cranium of Chimpanzee, a prehistoric man, and modern man - ba. basion; o: opisthion; - i: inion; l: lambda; b: bregma; n: nasion; pr: prosthion; ethmoid fossa. (BOULE) -

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GILBERT COLLECTION.

No. 2355.

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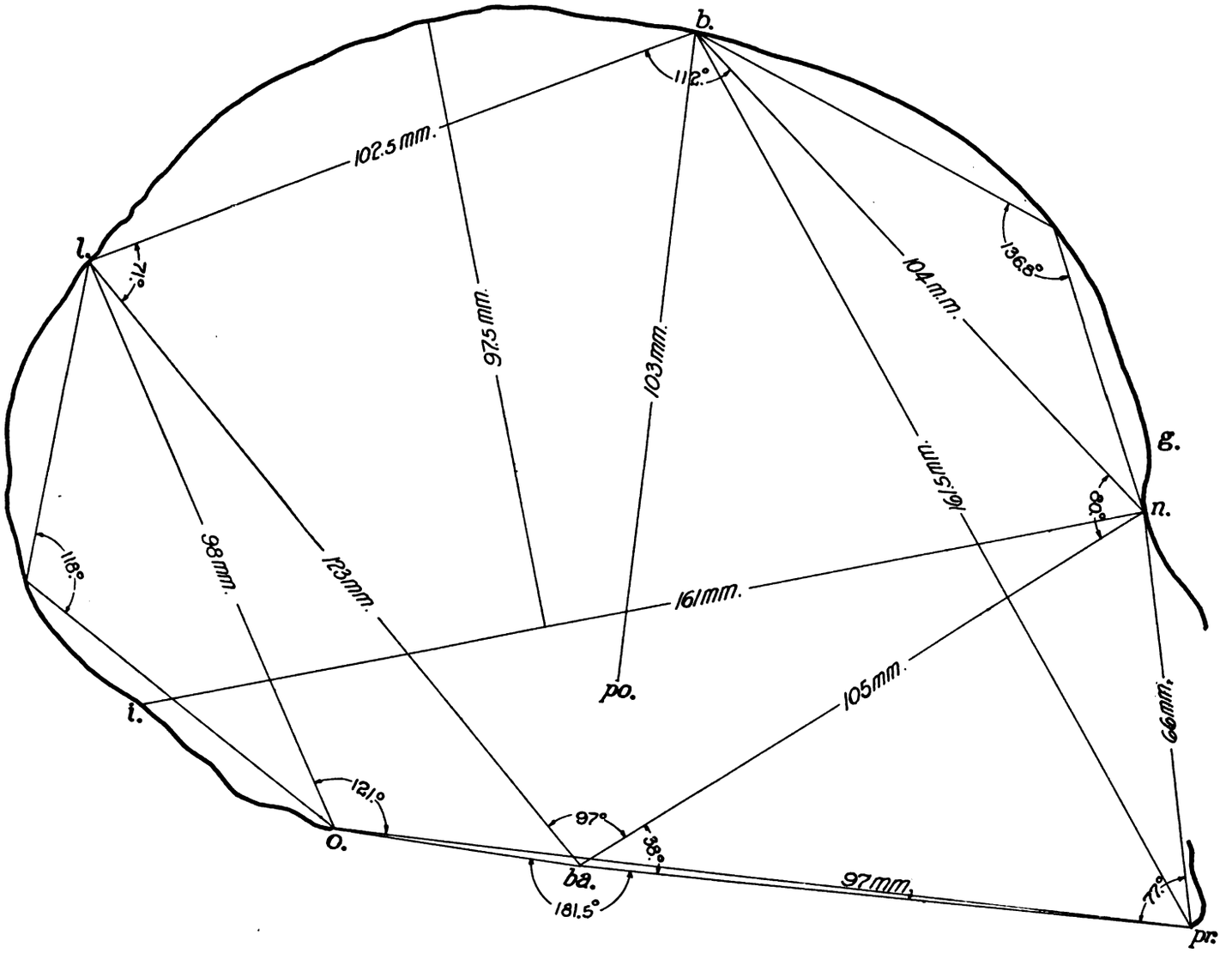

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	Peabody	Peabody	Peabody	Peabody	Peabody	Peabody	Peabody	Peabody	Peabody	Peabody	
56	10.271 ♀	10.272 ♀	11.249 ♂	15.306 ♂	15.307 ♂	15.308 ♂	15.310 ♂	15.378 ♀	18.225 ♂	18.881 ♀	1 2
..	.....	.....	35–40	45–50	25–30	30	45–50	.....	.....	30	3
..	.....	.....	188	188	188	180	179	179	182	180	4
..	.....	.....	177	175	180	172	169	166	175	169	5
..	.....	.....	173	173	174	168	163	161	169	166	6
..	.....	123	126	117	138	118	122	127	126	121	7
..	.....	.....	314	313	345	301	314	310	315x	307	8
..	120	.....	117	125	131	128	130	114	115	128	9
12	.....	109	114	113	122	107	107	113	111	111	10
..	107	108	106	107	118	106	118	105	106	112	11
..	.....	.....	.....	.....	.....	109	.....	.....	108	113	12
..	.....	.....	75	72	71	67	76	68	65	69	13
..	.....	.....	35	36	36	33	32	32	35R 33L	35	14
..	.....	.....	51	55	57	48	52	51	51	51	15
..	.....	.....	.....	.....	.....	32	.....	.....	34	32	16
93	.....	94	92	96	94	93	99	92	92	89	17
94	.....	104	106	105	106	106	105	102	104	105	18
96	.....	95	102	98	101	101	98	95	97	99	19

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	Amherst	Amherst	Amherst	Amherst	Amherst	Amherst	Amherst	Amherst	
3	2365 ♂	2366 ♀	2367 ♂	2369 ♂	2417 ♀	2817 ♂	2818 ♀	2946 ♂	1 2
0	35–40	35–40	.....	.....	.....	35	.....	.....	3
8	186	158	176	188	178	179	178	198	4
8	183	150	168	184	167	171	165	196	5
5	179	147	165	176	160	167	160	194	6
0	133	114	124	133	132	131	116	140	7
9	306	288	299	327	310	311	311	317	8
0	112	121	119	125	122	112	117	115x	9
2	118	103	111	117	114	118	104	123	10
7	103	106	108	111	110	99	107	102	11
..	105	.....	119	.....	107	106	108	118	12
..	73	61	70	75	64	64	67	68	13
..	36	31	35	34	37	31	32	34	14
..	51	46	54	36	44	50	47	50	15
1	32	.....	32	.....	33	35	32	33	16
3	97	87	93	96	84	93	90	97	17
5	109	94x	102	118	95	106	103	109	18
3	101	88x	95	102	87	96	92	99	19

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VOLUME V MAY, 1916

The Collection of Osteological Material from Machu Picchu

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UNDER THE AUSPICES OF YALE UNIVERSITY
AND
THE NATIONAL GEOGRAPHIC SOCIETY

NEW HAVEN, CONNECTICUT
1916

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The Collection of Osteological Material from Machu Picchu

By George F. Eaton.

In the following pages will be found a report upon the collection of osteological material gathered from Indian graves at Machu Picchu, by the Peruvian Expedition of 1912, under the auspices of Yale University and the National Geographic Society. As there was no trained Ethnologist on the staff of the Expedition it has seemed best that this report should include an account of my field work as well as of my subsequent studies on the material. The descriptions of the graves and the purely osteological discussion of the dry bones have been further supplemented by observations on the mortuary customs of the people whose burial places were excavated and by references to other topics of interest relating to the material that has passed through my hands. It has also been found advisable to illustrate practically all the artifacts that were taken from a few of the most interesting graves, in order that the reader may gain an essentially complete idea of the garniture of the graves and thus be better able to form an independent opinion regarding the age of the interments and the period to which the greater part of the skeletal material belongs.

The general appearance of the ancient city of Machu Picchu and its situation on the mountain-spur of the same name, that rises precipitously from the Urubamba River, are well known through the preliminary account of the work of the Expedition, published by the Director, Professor Hiram Bingham, in the National Geographic Magazine for April 1913. It is here only necessary to refer to the contour map of Machu Picchu and vicinity, to be found at the end of the present report, in order to show where the inhabitants of the city buried their dead. I have therefore indicated on this map by the serial numbers 1 to 52 inclusive, the locations of nearly all the caves or graves from which, with two exceptions, I personally obtained human remains or other articles mentioned in this work. Unforeseen delays in completing the topography of other regions visited by the Expedition resulted in my daily search for graves being made without the aid of a map, and the location of the graves on the accompanying map, which was drawn after my departure, is in many cases only approximately correct. Whenever possible, bearings of familiar landmarks were of course taken, but usually my only resource was a dead reckoning, kept as best I could, while my Indian assistants hacked the way with their machetes through a dense blind jungle-growth. Graves or caves numbered 53 to 107, which were excavated after my departure, I have thought best, for reasons that will appear more clearly further on, not to attempt to locate definitely on this map, but merely to quote the statement of their location made by the native Indian assistants and recorded in the field notes of Mr. Ellwood C. Erdis, the Archæological Engineer of the Expedition, who took charge of this branch of our work during the latter part of the season.

A few hours' search in and about the city, even before much of the brushwood had been cleared from the ruins, made it appear very unlikely that human remains of scientific value awaited excavation there. This conclusion, which ultimately proved correct, rendered it necessary to extend our quest beyond the city walls and to search the almost impassable

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slopes of the mountain. At this point the Director's previous experience of the wonderful results to be obtained from liberal offers of prize-money for discoveries, suggested the means of overcoming all obstacles. A schedule of rewards, varying according to service rendered, was offered to anyone who could find and guide us to graves containing valuable material. Every Indian employed about our camp was then sent out prospecting. At evening, crest-fallen, cut and bruised, and if possible more ragged than before, all straggled back, with the exception of three men who had moved with their families a year or two previously from somewhere down in the valley, to make their homes in a clearing near the ruins. These men, Alvarez,* Richarte and Fuentes, were consequently more familiar with the lay of the land than were the peons hired from distant places. They had, besides, acquired a knack of wriggling snake-like through the jungle when the rank vegetation was not so dense as to require vigorous use of machetes. They reported having found burial-caves about one-third of the way down the northeast slope of the mountain. To this locality they conducted the Director and me, on the following day, and from that time on, during the four weeks that I spent in camp at Machu Picchu, these three Indians were my faithful guides and assistants in the search for the remains of the former inhabitants of the city.

As will be seen in the following pages, graves were found at various places on the steep sides of the Machu Picchu Mountain, from its very foot close to the Urubamba River up to an altitude of 1200 feet above the ruins. In most instances the human remains had been placed in the cave beneath the bowlders of the mountainside, these caves having usually been made especially for that purpose, though a few of them were evidently of natural origin. Just as no two bowlders were of exactly the same size and shape, so the forms of the burial caves were found to vary. This will be easily understood by reference to the diagrams and photographs that follow.

In only a few instances were the remains actually *inhumed,* that is, entirely covered with earth. The large majority of burials were made in caves, where the remains would be well protected from moisture and sunlight. When skeletal material was obtained from such sheltered places, there were usually indications that the greater part of each mummy or body had been originally left above ground. I think that whenever there was sufficient head-room, the mummies were placed sitting in the contracted position, and it is very likely that shallow pits not more than a few inches deep may have been excavated in the floors of the caves, in which the mummies could be set up to keep them from toppling over. A little earth may often have been banked around the crouching mummies for the same purpose, and when, after the lapse of centuries, the mummy wrappings and desiccated human tissues finally disintegrated, permitting the skeletons to fall apart, the scattered bones would gradually become more or less covered by slowly accumulating humus. Vegetation played a freakish part in the destruction of the bones, even when inorganic nature had touched them but lightly. Frequently the shafts of long bones were traversed throughout the length of the medullary cavity by wire-like stems of bamboo-grass, and on one occasion when an attempt was made to lift a perfectly preserved skull from the floor of a cave, it was found to be

* Alvarez, moreover, fancied himself a sort of hunter-naturalist, being the proud owner of an antique muzzle-loading gun, with the half-cock notch worn out, a weapon more dangerous to friends than to wild game, but serviceable enough to kill, after three discharges at close range, a very small bear-cub, which he authoritatively informed me was "Un animal chico, lo mismo un gato." I provisionally accepted his classification of the Carnivora, as a means of persuading him to leave the gun at home.

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held fast by a stem of the same plant species, that had wormed its way through the foramen magnum into the brain chamber and out again by way of the superior orbital fissure.

What to save, when excavating archæological material in a region where the facilities for packing and transporting fragile articles are meager, is always a vexatious problem. Theoretically one should save everything, but in practise it often becomes necessary to leave behind a good deal of material that one would hesitate to discard, after it had been brought home.

Although the original plans of the Expedition included the collection of potsherds only when their form or decoration appeared to have some special significance, the possibility of piecing together a large proportion of the sherds found in sepulchers, and of restoring in this manner many valuable pieces of Indian pottery, became apparent early in the course of the work. I am convinced that the Director's readiness to provide the transportation necessary to save this material has been fully justified by the results. The same care in saving practically all those osseous fragments that were not immediately recognized as worthless has also brought its own reward. While searching for burial caves and excavating them under difficult and often trying conditions, keeping a bright lookout for scorpions and venomous serpents—one hand for himself and one for the ship, as in the old sailor's adage—it is impossible for the collector to estimate at a glance the ultimate value of every specimen he finds, such as a sexually characteristic pelvic fragment or a bit of beef-bone. Under such circumstances the only safe and sure method to follow is that enjoined by the late Professor O. C. Marsh upon his assistants—"Permit nothing to pass from your hands unrecognized."

Acknowledgments.—Grateful acknowledgment is due to the following: to Señor Don Mariano Ignacio Ferro, the owner of the wonderful Finca Cutija, which contains the ruins and graves of Machu Picchu, for permission to collect on his land, and for instructing his employees to aid us; to the Peruvian Government, which gave permission to conduct excavations and furnished us part of the necessary labor, and in particular to their Representative at Machu Picchu, Lieutenant Sotomayor, who acted as Interpreter and rendered efficient service; to W. L. Morkill, Esq., Representative of the Peruvian Corporation in Lima, for many favors, and particularly for his aid in persuading the Peruvian Government to permit the collections made at Machu Picchu to be sent to Yale University; to Edward S. Harkness, Esq. (Yale College, 1897), whose generous interest made possible the archæological work at Machu Picchu; and finally to the National Geographic Society for their generous contributions toward the general expenses of the Expedition and in particular for meeting the cost of the plates and illustrations in this paper. All photographs of bones and of artifacts were taken by Mr. Charles N. York, of New Haven, Connecticut, and I am indebted to Doctor Arial W. George, of Boston, Massachusetts, for the excellent skiagrams of pathological specimens. Mr. William Baake made the drawings of the skulls of new mammals as well as of many artifacts, and prepared the diagrams of caves from the hasty drafts in my field notes. The sketches of the rock-sheltered terrace and the wayside shrine Mr. Theodore Diedricksen has obligingly executed from such material as I could offer for his guidance.

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FIGURE 1.—View of Cave 1 after the protecting wall of irregular stones had been partly demolished. Photograph by Hiram Bingham.

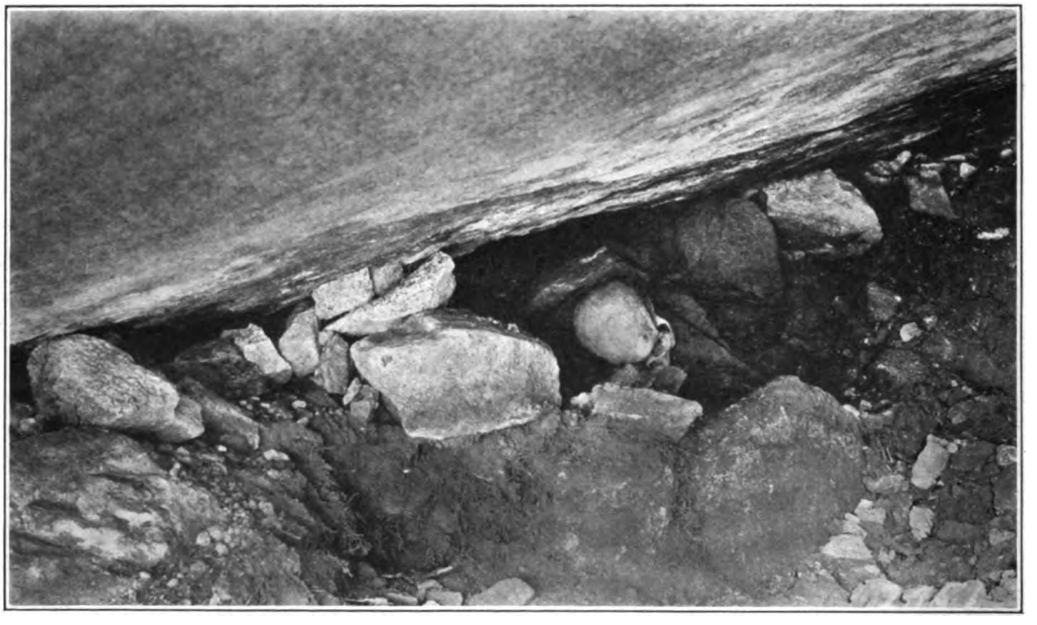

FIGURE 2.—Near view of Cave 1, showing the skull fallen on its side. Photograph by Hiram Bingham.

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THE GRAVES.

First Series, 1 to 52.

Cave 1.

The first burial place visited was an artificial cave beneath a large bowlder, about one-third the way down the mountainside and northeast from the ruins. Text-figures 1, 2 and 3 show the cave and the thick jungle growth that masked it.

In this cave and in a good many others similar to it, human remains were well protected by the bowlders from rain and surface water, sufficient ventilation being had through the interstices of the loosely constructed wall to insure the preservation of the bones, long after the mummy wrappings and softer human tissues had disintegrated. The protecting wall was stout enough to keep out all the larger mammals that might otherwise enter and scatter the contents of the grave, and as may easily be seen in the view shown in text-figure 3, the burial place was so well screened that chance visitors to the region might pass within a few feet of the cave without seeing it.

When the cave was opened, the bones of its sole occupant were found as indicated in text-figure 4. In this diagram and in many others that follow, no attempt has been made to figure all the skeletal parts, as that would have been needlessly confusing.

The bones were those of a woman about thirty-five years of age. The skull (Ost. Coll. 3156)* which had fallen on its side is of the broad and short type (brachycephalic) that is generally regarded as characteristic of the Peruvians of the middle coast region. The burial had evidently been made in the *contracted position,* that is to say, with the legs flexed and the knees drawn up close under the chin. In fact the larger bones of the legs still protruded from the ground in that position. On removing them, it was noted that the proximal ends of the femora and the distal ends of the tibiæ were entirely decayed. References to similar conditions of decay will be found in the descriptions of many other graves. A long narrow splinter of stone that had probably been dislodged from the front wall rested across the lower jaw. Other bones lay on the ground just where they had fallen when the skeleton dropped apart. No metal articles were found with the remains, and no pottery was obtained inside the cave, but the sherds of the following earthenware vessels were found at the surface of a pile of earth and small stones that partially concealed the protecting wall: Two beaker-shaped ollas† or cooking pots, fire-blackened on their bases and sides from long use, one large two-handled dish and a medium-sized dish of the same form.

* The number of the specimen in the Catalogue of the Osteological Collection of the Peabody Museum of Yale University to which the skeletal remains of Man and of lower animals, collected by the Peruvian Expedition of 1912, were presented.

† For the explanation of terms used in this report with reference to pottery from the graves, cf. "Types of Machu Picchu Pottery," by Hiram Bingham, American Anthropologist (N. S.), Vol. 17, No. 2.

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FIGURE 3.—The approach to Cave 1, from a distance of 20 feet. The entrance to the cave is in line with the center of the view. This illustrates the difficulty of finding burial caves and of carrying away their contents after excavation. Photograph by Hiram Bingham.

CAVE 2.

This burial place, which was very near Cave 1, was excavated by Professor Bingham. Fragments of two small adult human skulls were collected. These may be female, but they are too poorly preserved to admit of sexual determination. No pottery or bronzes were found.

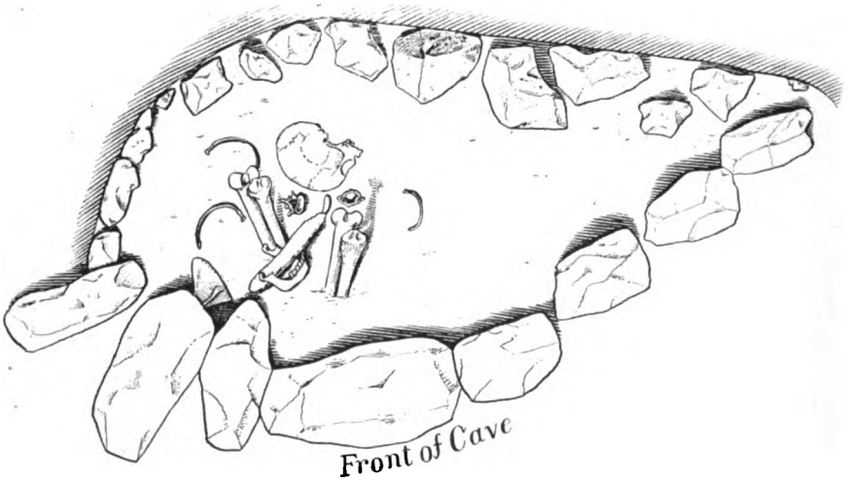

FIGURE 4.—Diagram showing the position of the human skeleton in Cave 1.

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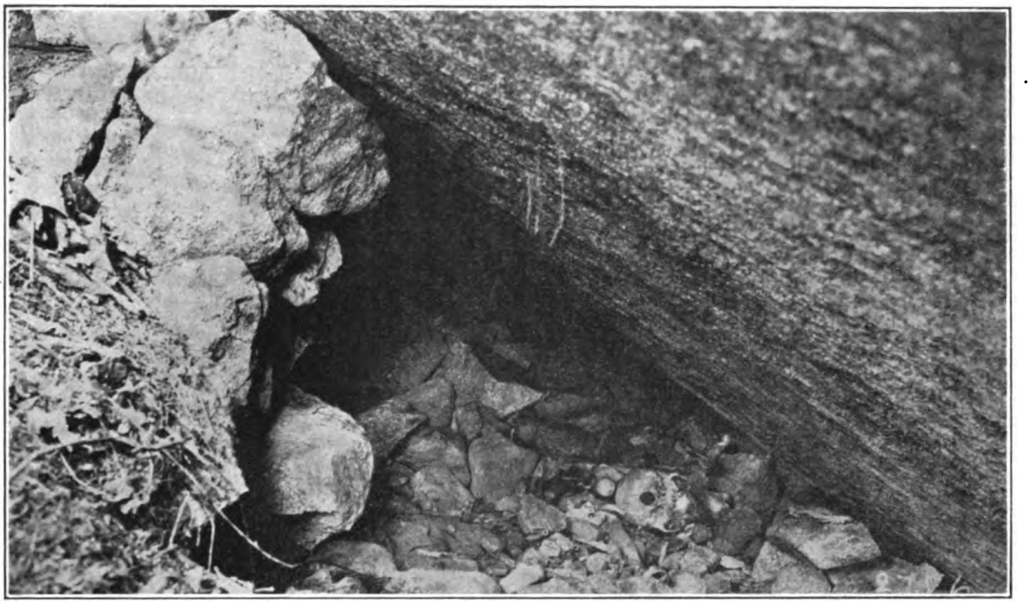

FIGURE 5.—View of Cave 3 after the protecting wall had been partly removed. A human skull and other bones may be seen on the rough floor. Photograph by Hiram Bingham.

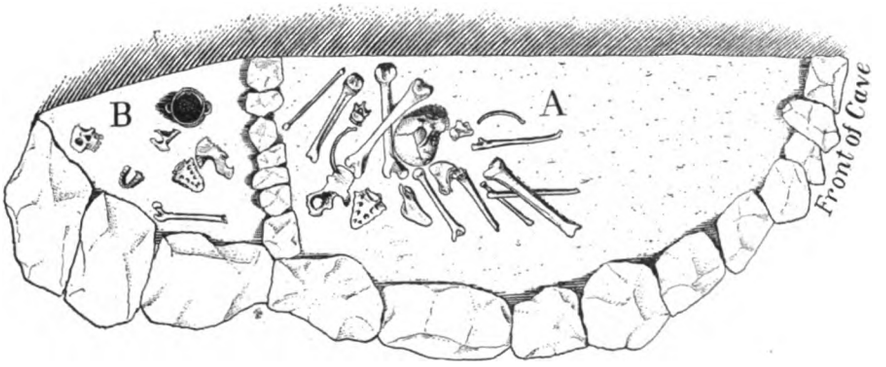

FIGURE 6.—Floor plan of Cave 3, showing human bones in the two compartments of the cave, the compartment first entered being denoted by the letter A, and the inner compartment by B.

CAVE 3.

This burial cave, which was not far from the two preceding, was also beneath a large bowlder. The photograph reproduced in text-figure 5 shows a human skeleton just as it appeared on the floor of the cave. I have indicated the position of these bones more clearly in text-figure 6. The skeleton (Ost. Coll. 3157) is that of a woman of about thirty-five years of age, the skull being of the oblong type usually found in the mountain regions. While the skeleton is of robust proportions, necrosis of the right maxilla has been associated with alveolar abscess, and the left femur shows an extensive periostitis. Photographs and

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skiagrams of this bone and also of the right femur, which is not affected by disease, are shown in Plate XXXII. Near the protecting wall a broken beaker-shaped olla was found. Tearing out what seemed at the time to be the continuation of the retaining wall at the far end of the cave, a second chamber, marked B in the diagram, was exposed. Here we found a perfect small pot (M. P. 835)* shown in Plate V, and the poorly preserved skeleton of a

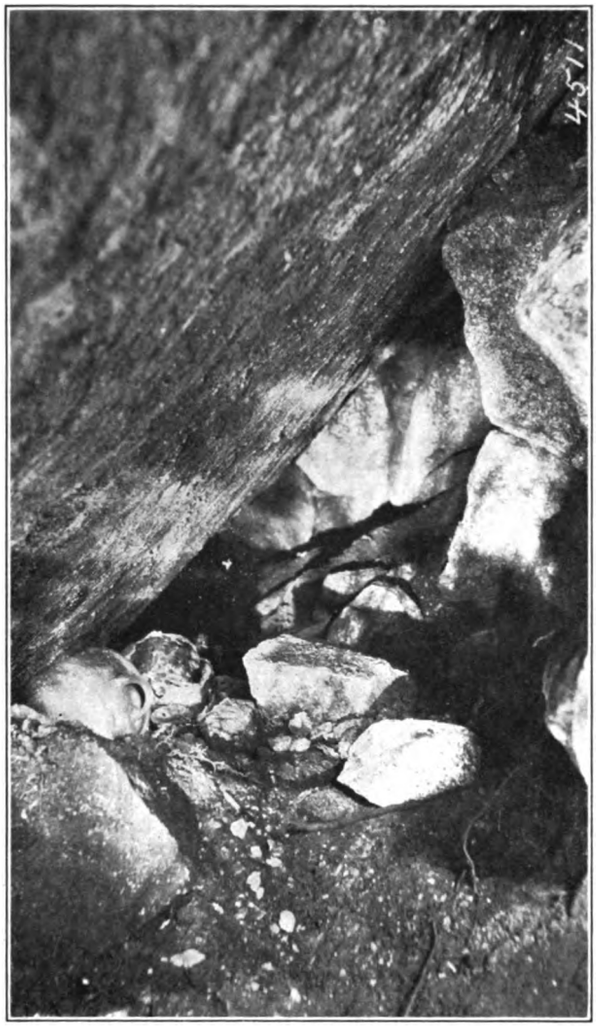

FIGURE 7.—View of Cave 6, showing a complete two-handled dish or olla and a fragmentary human skull. Photograph by the author.

young woman. The proximal symphyses of the humeri have not fused with the shafts, and the basial suture of the skull is not entirely closed, yet the third molars are in place and the femora appear to have attained their full length. The latter, however, are the smallest nearly adult thigh bones I have seen in the collection.

*This number refers to the Provisional List of Pottery, Bronzes, etc., found at Machu Picchu.

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Cave 4.

Beneath an enormous overhanging bowlder, in the same region as the graves already described, we found a large irregular cave of two principal chambers, one of them leading down four or five feet underground. These graves had perhaps been visited by treasure-hunters or wild beasts, for the contents were strewn within and without the cave. Various fragmentary and decayed bones, as well as many potsherds, were collected. From the latter, two good vessels have since been restored, namely, a deep two-handled dish and a beaker-shaped olla. The skeletal material includes six fragmentary human skulls, only two of which (Ost. Coll. 3158 and 3159) are available for measurement. Five of these skulls are evidently female, one of them probably so. One presents in a moderate degree the type of

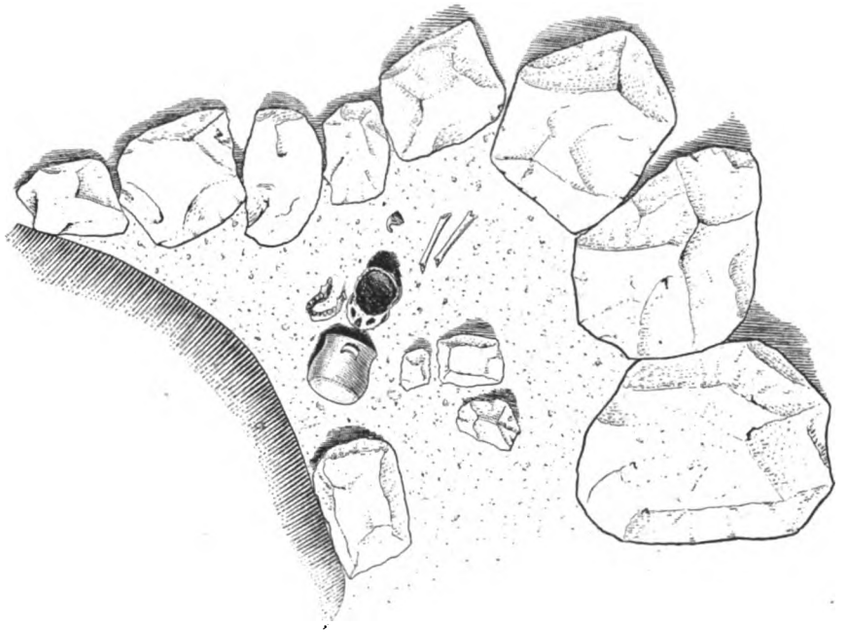

FIGURE 8.—Floor plan of Cave 6, showing position of bones. The damaged skull faces the overturned olla.

artificial deformation most commonly practised in the highlands of Peru and Bolivia, and another shows considerable fronto-occipital flattening. A quantity of fragmentary human long bones and other skeletal parts found with the skulls add little or nothing to the story. No bones of lower animals were collected except a weaver's pointed tool or bodkin 16 cm. long (Ost. Coll. 3382), made by grinding to a point a llama's metacarpus or cannon-bone. A better preserved implement of the same design is shown in Plate IV, figure 10.

Cave 5.

From this burial cave, which was excavated under Professor Bingham's supervision, and which was only a few rods distant from the last described, two human skulls were taken, also a pair of femora decayed at the proximal ends, probably as the result of burial in the contracted position, and one humerus. The only pottery that was collected was a badly broken beaker-shaped olla.

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The skulls are good specimens; one (Ost. Coll. 3160), which is presumably female, is of the brachycephalic type of the coastal people, while the other (Ost. Coll. 3161), which is undoubtedly female, exhibits the style of deformation known as Aymara and practised in the highlands. This skull is very similar to that shown in Plate XXVIII. The first individual described from this cave was about thirty-five years of age, the latter a few years younger.

Cave 6.

The next burial cave visited was at about the same level as those previously examined, but a little further around toward the north slope of the mountain. The cave and its contents are shown in text-figures 7 and 8.

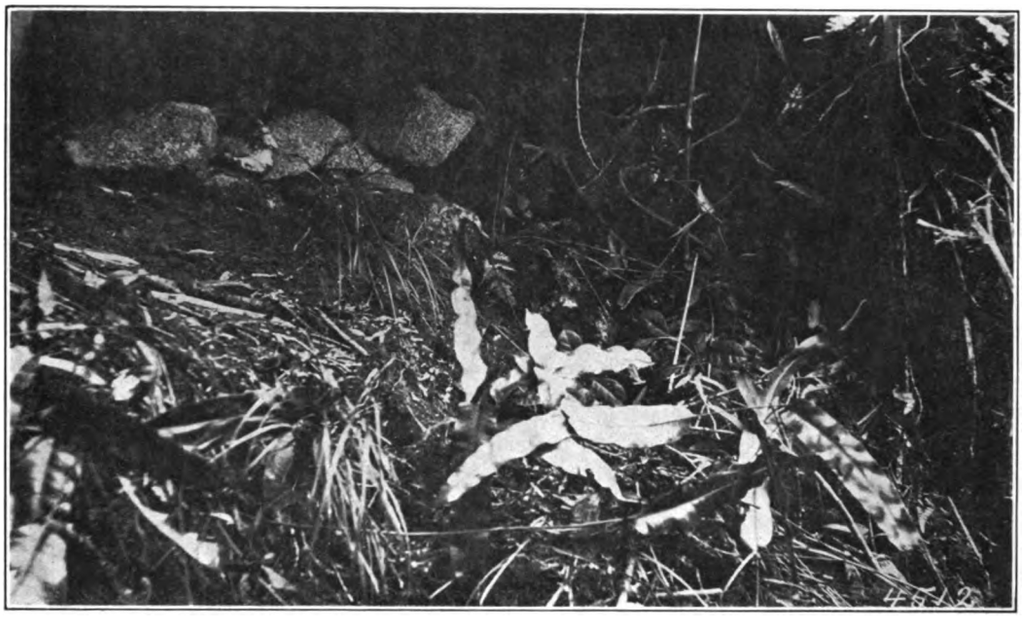

Figure 9.—View of Cave 7. Because of the irregularity of the ground it was possible to photograph little more than the low sill of stones, after cutting away the jungle growth in the foreground. Photograph by the author.

The skeletal material found here was meager and fragmentary. It represents a small woman about twenty-five years of age, whose brachycephalic skull shows her affiliation with the people of the coast. Besides the skull were found the mandible and the shafts of a tibia and of a humerus, the long bones being of small size and having their articular ends decayed. No other bones were seen. Two pottery vessels had been placed at the grave. One of these (M. P. 834) is a perfect deep two-handled dish of fine red ware, which lay on its side near the skull. The other which was not recovered intact was a small dish of the same general form as the first. The incomplete condition of the skeleton is hard to explain. The protecting wall at the front of the cave had already been thrown down or had fallen, when we first visited the place, and it is possible that the grave had been previously desecrated by treasure-hunters or by wild beasts. The presence of a whole pot, however, argues against the likelihood of treasure-hunters having been there, for even if they did not wish to carry away, for their own use, this plain and not readily saleable, yet still serviceable vessel, they would probably have destroyed it, according to their wont.

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Cave 7.

This burial place was near the last described. A low wall or sill of rough stones gave practically no protection to the cave, which was formed by two irregular bowlders, as shown in text-figures 9 and 10.

On the floor of the cave lay the skull and lower jaw of a young person about fifteen years of age and of unknown sex. Although too young to have reached its full development and too imperfect for accurate measurement, this skull appears to represent the brachycephalic coastal type.

In the ground beneath the skull was apparently the rest of a complete skeleton in the contracted position. Unfortunately these bones were so badly decayed that few of them could be saved, and I am unable to determine the sex. The body may have been partially inhumed,

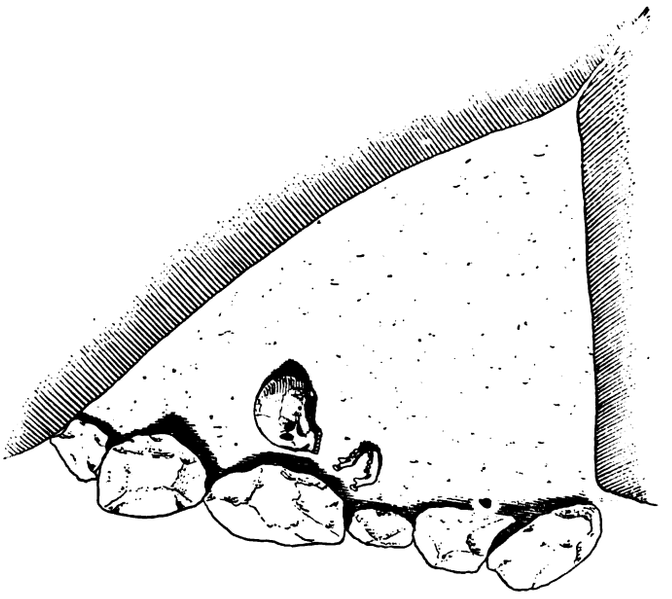

Figure 10.—Floor plan of Cave 7, showing the skull and mandible. The rest of the skeleton was inhumed.

the head alone remaining above ground, or else the earth of the loosely filled grave may have settled enough to expose the skull. No pottery or other articles, besides the human bones, were found in this cave.

Cave 8.

This was a small artificial cave beneath a bowlder on the north slope of the Machu Picchu Mountain about one-quarter of the way down to the river. The entrance was partially closed by piled-up earth and small stones. The cave contained only a few human bones, but these lay on the dry floor and were in a state of excellent preservation. Because the skeleton was incomplete, the grave was supposed to have been previously robbed by treasure-hunters. After careful consideration, and in the light of later experience, I am convinced that the grave had not necessarily been previously desecrated, but that, on the contrary, the few human bones that it contained may have become separated from the rest of the skeleton, when the mummy was taken out during some ceremony or was removed from one place of burial to another.

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The bones (Ost. Coll. 3162) are all of small size, and presumably belong to one individual, an adult female. They comprise a mandible, a scapula, the bones of one arm, a tibia and a fibula. The cave contained also the shell of a large land snail, probably an edible species from the Indian point of view. No pottery was observed.

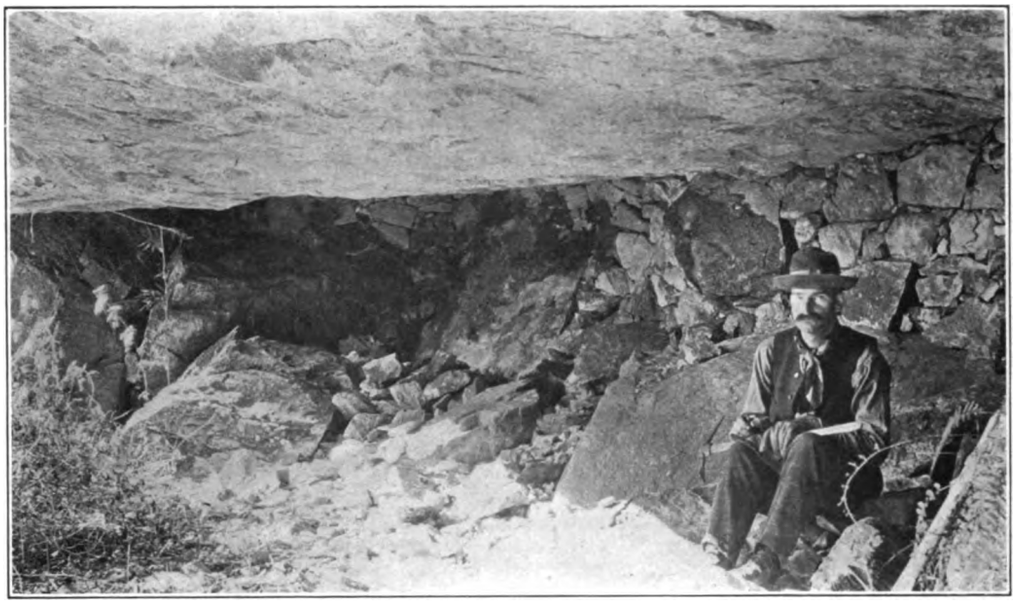

FIGURE 11.—View of a remarkably fine rock-shelter. Grave 9 was located at the far end. Photograph by Hiram Bingham.

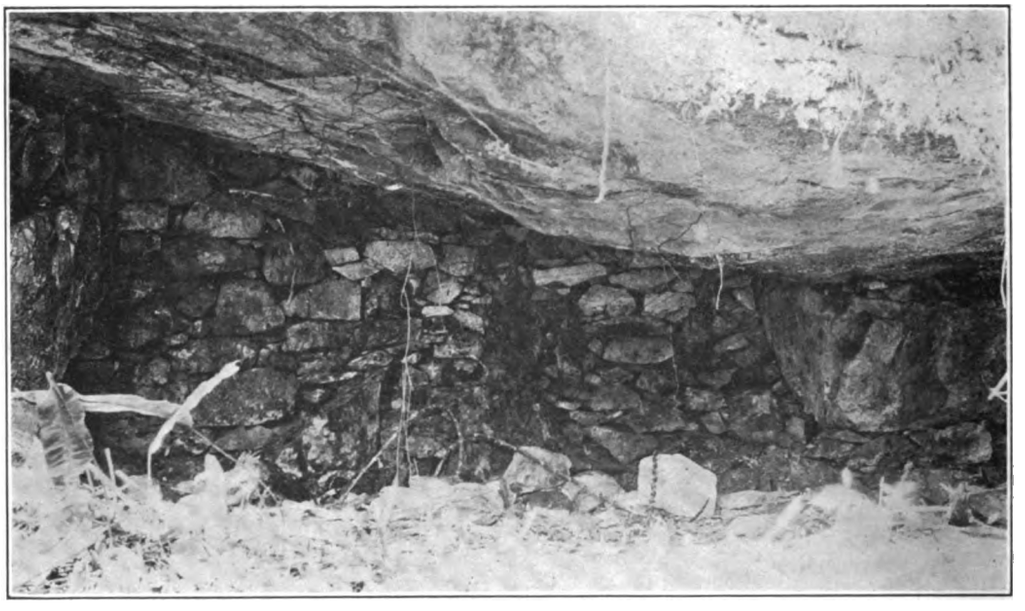

FIGURE 12.—Another view of the rock-shelter beneath which Grave 9 was located. Photograph by Hiram Bingham.

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Grave 9.

An immense rock-shelter, largely artificial in its structure, is situated on the mountain slope southeast of the ruins of the city and at an elevation 800 feet or 900 feet higher. It is the most perfect shelter of the kind that I have ever seen, the roof being formed by the horizontal under surface of a great bowlder, which is supported by stone work at the back and at the ends, while the entire front of the shelter is open to light and air. The nearly rectangular floor area is about 30 feet long and 15 feet wide, the headroom being ample for the average Peruvian Indian, though it was found to be insufficient for the taller members of the Expedition. Views of this shelter are reproduced in text-figures 11 and 12. It was the first burial place examined in what may be termed the upper cave region of Machu Picchu.

Potsherds lay strewn on the floor, many of them representing finely decorated vessels. One of these (M. P. 900), a handsome vase of the aryballus type, has since been restored from sherds that we have saved. It is shown on Plate V, figure 2.

Grave robbing is at best an unholy venture. The scientific collector of bones doubtless has better intentions than the mere treasure-hunter, but both follow, in part, the same course, and whichever one finds himself last in the race for the prize probably regards his competitor's work as unwarrantable desecration.

The broken pottery on the floor of the shelter may have been largely the work of treasure-hunters, but, if so, they lacked the energy, or knowledge of the game, to throw down part of the wall at one end of the place. This work of destruction on our part, as shown in text-figure 11, revealed a walled-up grave (Grave 9), from which we obtained the greater part of two human skeletons (Ost. Coll. 3163 and 3164). Some valuable parts of these skeletons we failed, however, to secure, for, in order to reach the bones, we had to dislodge some very heavy blocks of stone, and the danger of serious accident to ourselves and our native assistants led to our exercising a little more care than we might have done, had not the Surgeon of the Expedition been six days' journey distant. Our own bones seemed much more valuable to Science than those of the Ancient Peruvians!

The first skeleton (Ost. Coll. 3163) found here is perhaps that of a woman about forty years of age. The skull, which has a patent metopic suture and shows a moderate degree of Aymara deformation, does not readily admit of sexual determination, and we were unable to recover the pelvis. The other bones might pertain to either sex. The mandible demonstrates the enormous amount of distortion that can be caused posthumously. Its bicondylian diameter has been decreased about 20 mm., apparently by the weight of a fallen stone, and the transverse measurement of the inferior dental arcade reduced proportionately, yet without any fracture having occurred other than a slight injury at the left gonion. As a result, while the upper and lower teeth match perfectly in size and wear and while a good contact can be made on one side or the other at a time, the mandible cannot be set in place.

The second skeleton found here (Ost. Coll. 3164) is that of a young woman about twenty years of age, whose naturally brachycephalic skull testifies to her coastal birth or ancestry.

Considerable llama flesh had been provided at this grave, as numerous bones of that useful animal were seen; but this was not the only meat provided, for a few bones of a paca, *Agouti* sp., were found, which are referred to again on page 89; also a scapula of a small deer, probably *Pudua* sp., and some bones of one of the so-called Peruvian Hares, *Lagidium* sp. An abundance of charcoal had been provided for the use of the dead, and one wonders whether the flesh placed in the grave was cooked or raw.

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A weaver's pointed tool made of llama bone (Ost. Coll. 3383) was found, differing in style from the bodkin obtained in Grave 4, as it was made from the upper two-thirds of a tibia, the lower end of the piece having been ground to a slender point (Plate IV, figure 9). Another implement from this same grave is the thin knife-like bone tool (Ost. Coll. 3384) shown in Plate IV, figure 14.

FIGURE 13.—View of Cave 11 during excavation. Flashlight photograph by Hiram Bingham.

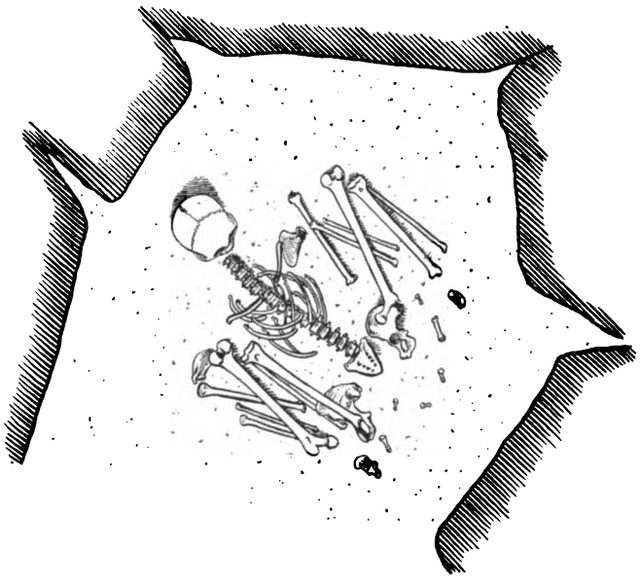

FIGURE 14.—Floor plan of the recess at the rear of Cave 11, showing position of the human skeleton.

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A portion of the wall shown in text-figure 12 was also demolished, and the serial number 10 was given to the place, as we supposed at first that we had located another grave; but we were disappointed, and the assigned number remains nude.

Cave 11.

Not far from the rock-shelter described above, a grave was found in a small chamber at the rear of a large natural cave formed by a group of irregular bowlders. Text-figure 13 shows an interesting photograph of this place. My two most helpful native assistants, Alvarez and Richarte, stand at the rear of the cave, the latter being nearly in the center of the view. In the foreground is the fiber packing case carried by the Indians during our days on the mountainside. When filled with dry bones packed with excelsior or moss, the case made only a moderate load for a man; but when, as often happened, the cargo was largely composed of pottery, none of the Indians was overanxious to serve as cargador on the way back to camp. On these occasions Alvarez and Richarte generally persuaded the dull-witted Fuentes, who is seated at the left, that it was his turn to carry the case. Although the poor fellow was sadly imposed upon by his livelier companions, I must confess to some enjoyment of the trick practised on him, for he always groaned and complained that the load was too heavy, even when I knew it to be extremely light. The Indian at the right of the view is the gendarme Jiminez, who was detailed to assist us until the end of our work.

The nearly complete skeleton (Ost. Coll. 3165) of a woman of the coast about fifty years of age was taken from this grave, the mandible being apparently the only part lacking. The skull (Plate XV) is unusually robust for a woman, having very heavy orbital margins and correspondingly full development of the glabella and supraorbital ridges. A healed lesion is presented near the right parietal eminence, the cranial wall at this point being 18 mm. in thickness. The position of the skeleton, as shown in the diagram, was that of a mummy originally made up in the contracted position, that had either been laid on its back or had fallen backward when decay of the soft tissues caused the bones to drop apart. For the enlightenment of those of my readers who are interested in the inflammatory diseases of the Peruvians, I have had two very interesting skiagrams made of this skull. These are shown on Plate XXXIII. Views of the pelvis may be seen on Plate XXIX.

A mandible of a child about eighteen months old was found in the grave. This may be a relic of an earlier burial. We also collected several fragments of llama bones, representing food for the dead; also a ladle or deep plate from which the handle had long ago been lost, and part of a medium-sized beaker-shaped olla. The only other article saved was a needle, 87 mm. long, made from a plant spine by drilling a small hole in the basal end. Without the pierced eye, one of these spines makes an excellent pin or skewer for giving first aid to a badly rent garment. Nature provides a generous supply of these handy pins; in fact, it is sometimes painfully evident that the supply exceeds the demand.

Between the excavations of Graves 11 and 12, three caves were visited, but nothing was found to indicate that they had ever been used for burial purposes. It was of course not always possible to distinguish an unoccupied natural cave from a burial cave, until the vegetation and earth had been removed from the entrance.

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Cave 12.

This burial place in the lower grave region contained a very poorly preserved skeleton. Fragments of a skull and a complete mandible, the only parts that were saved, belong to a small adult female. I am unable to state whether the skull was of the coastal or of the mountain type. A broken beaker-shaped olla was the only other article found. In this instance, the mummy, in the contracted position, seemed to have been nearly covered with earth and stones.

Cave 13.

In this cave, which was near the last that I have described, we found the decayed skeleton (Ost. Coll. 3166) of a woman about fifty years of age and presumably of highland birth,

Figure 15.—View of entrance to Cave 15. Photograph by the author.

as the skull exhibits a moderate degree of Aymara deformation. The skull and the long bones are rather strongly developed, and were it not for the evidence afforded by the pelvis might have been mistaken for those of a small man. A heavy bronze pin about 11 cm. long had been interred with the remains, and in the cave had been placed the woman's cooking pot, a dark red, fire-blackened beaker-shaped olla. No llama bones were found, but the skull (Ost. Coll. 3316) of a large rodent of the genus *Agouti* showed that some flesh had been provided for the supposed needs of the dead. This skull, although not that of a mature animal, is a valuable addition to the collection, as it appears to be distinct from any species that has yet been described under the genus. For the description of this new species, the reader is referred to page 89. Remains of eight animals, presumably of the same species, were obtained from graves and middens in and near the city. This number

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of individuals is enough to show that flesh of the paca, as these animals are commonly called, was a recognized article of food at Machu Picchu. I note with great interest M. J. Stolzmann's statement (Proc. Zool. Soc., London, 1885, page 167) that in comparatively recent times the flesh of *Agouti taczanowskii* was highly esteemed by the Indians of Equador. "La viande du *'Sacha-qui,'* qui possède un goût exquis, est très recherchée par les habitants du pays."

Cave 14.

It was impossible to secure a good photograph of this burial place in the lower cave region, on account of the steepness of the mountain slope, which prevented the setting up of the camera at a suitable distance. The cave was beneath a large rock. Its length from front to rear was about 20 feet, and its width 8 feet; its height in front 2½ feet, and at the rear about one foot. A few nondescript rotten fragments of bone lay on the floor, and at the rear of the cave, just beneath the earth and cobbles of the floor, we found the sherds of five earthenware vessels, namely, two ladles or deep plates, two pelike-shaped jugs and a two-handled flat dish (M. P. 932).

The two-handled flat dish has been restored since the return of the Expedition and is an interesting article. A photograph of it is reproduced on Plate V, figure 3. A small bronze knife (M. P. 747; Plate II, figure 1), with flat pierced handle, was also found. Digging down under these objects to a depth of nearly five feet, we brought to light the decayed fragments of two skeletons—one of them that of a small adult woman of highland stock, whose skull, with patent metopic suture, had been deformed in the Aymara style. The other skeleton belonged to a small woman, whose apparently undeformed skull is too imperfect for accurate description.

Cave 15.

This burial cave among the rocks of the lower grave region contained the fragmentary and decayed skeleton of one individual, a young person, probably female, of about sixteen years of age. The undeformed immature skull is so highly brachycephalic, the cranial index being 86.8, that I suppose the girl represents the people of the coast. The burial was in the contracted position, but the skull had fallen back and lay on the floor.

Fragments of the skull of the new species of *Agouti*, described on page 89, were also found. There was no pottery.

Cave 16.

This burial cave, beneath a bowlder of the lower grave region, was deep and narrow. One of my Indians crept in, and dug out the fragmentary skeleton of a well-developed man of the brachycephalic coastal type, one of the few that I found at Machu Picchu. The skull (Ost. Coll. 3168) of the man, who was about forty years old, is shown on Plate XVI. The burial was in the contracted position, and the proximal ends of the femora and the distal ends of the tibiæ and fibulæ had entirely decayed. There were also a few sherds of an earthenware vessel, which may or may not be rightfully associated with this burial.

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Cave 17.

Nothing of especial interest was noted in regard to this cave. It was near the first burial place that we had visited. On the floor we found various bones of a medium-sized adult female skeleton (Ost. Coll. 3169), but no skull. There was some reason to suppose that the covering bowlder had settled, crushing some of the bones and rendering it practically impossible for us to get at the skull. A few potsherds of little or no value lay near the bones.

Caves 18 and 19.

The chief interest in these two burial caves, which were in the upper grave region, lay in the fact that careful and thorough excavation brought no human bones to light, only llama bones and a few poor potsherds. As these caves were too small and otherwise

Figure 16.—View of entrance to Cave 18. A low protecting wall or sill may be seen. Photograph by the author.

unsuitable for primitive dwellings, they must be regarded as burial caves from which the mummies had been removed, but whether by pious hands or by treasure-hunters it is impossible to determine.

Cave 20.

This cave was in the upper grave region of the Machu Picchu Mountain. No skull was found, neither were the femora nor humeri, but most of the other skeletal parts were present, though rather poorly preserved. While it is possible that the cave had already been plundered, I am disposed to believe that this may be one of those instances where the skeleton, or perhaps one should say the mummy, had been moved about until certain important parts were broken off and lost. The skeleton (Ost. Coll. 3170) is that of a small adult man. No pottery was collected.

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CAVE 21.

In this burial place, which was located very near the last described, three bodies had been interred. When the cave was entered, the only object of interest presented to view was the fragmentary skull (Ost. Coll. 3172) of a woman about twenty years of age. It is an oblong skull free from deformation, and the young woman was supposedly a native of

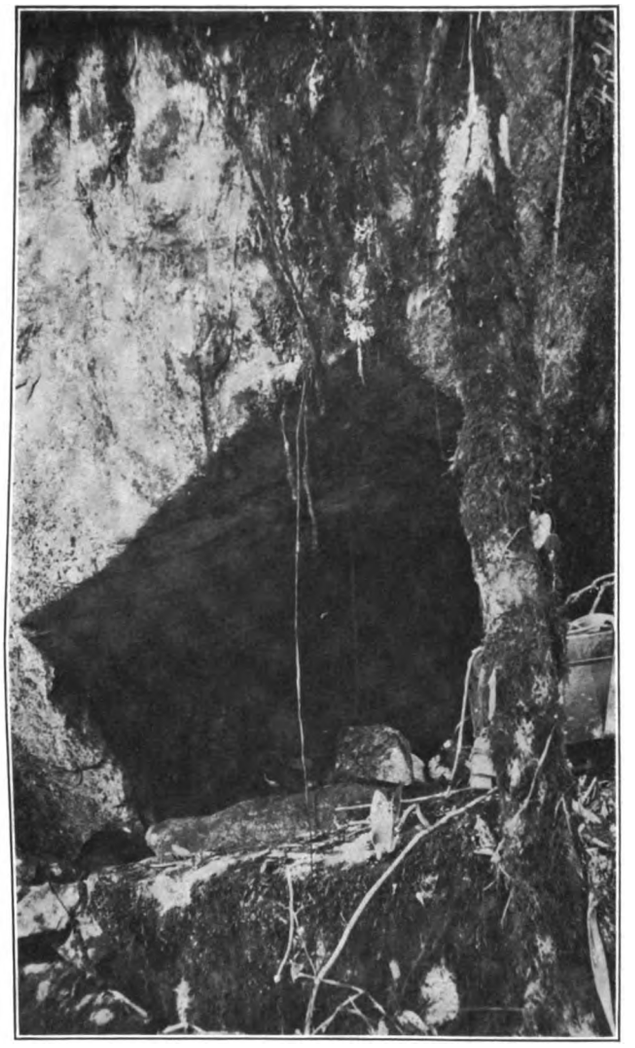

FIGURE 17.—View of Cave 20. Photograph by the author.

the highlands. The rest of the skeleton was poorly preserved. A little deeper in the earth floor of the cave a second skeleton (Ost. Coll. 3171) occurred. In this case the skull was better preserved and more truly dolichocephalic than the first. The sexually characteristic parts of the pelvis had decayed, and the form and size of the skull and the other parts collected, afford little help toward determining the sex. I am, however, disposed to regard the skeleton as male. Of the third individual interred here, only a few fragments of a small,

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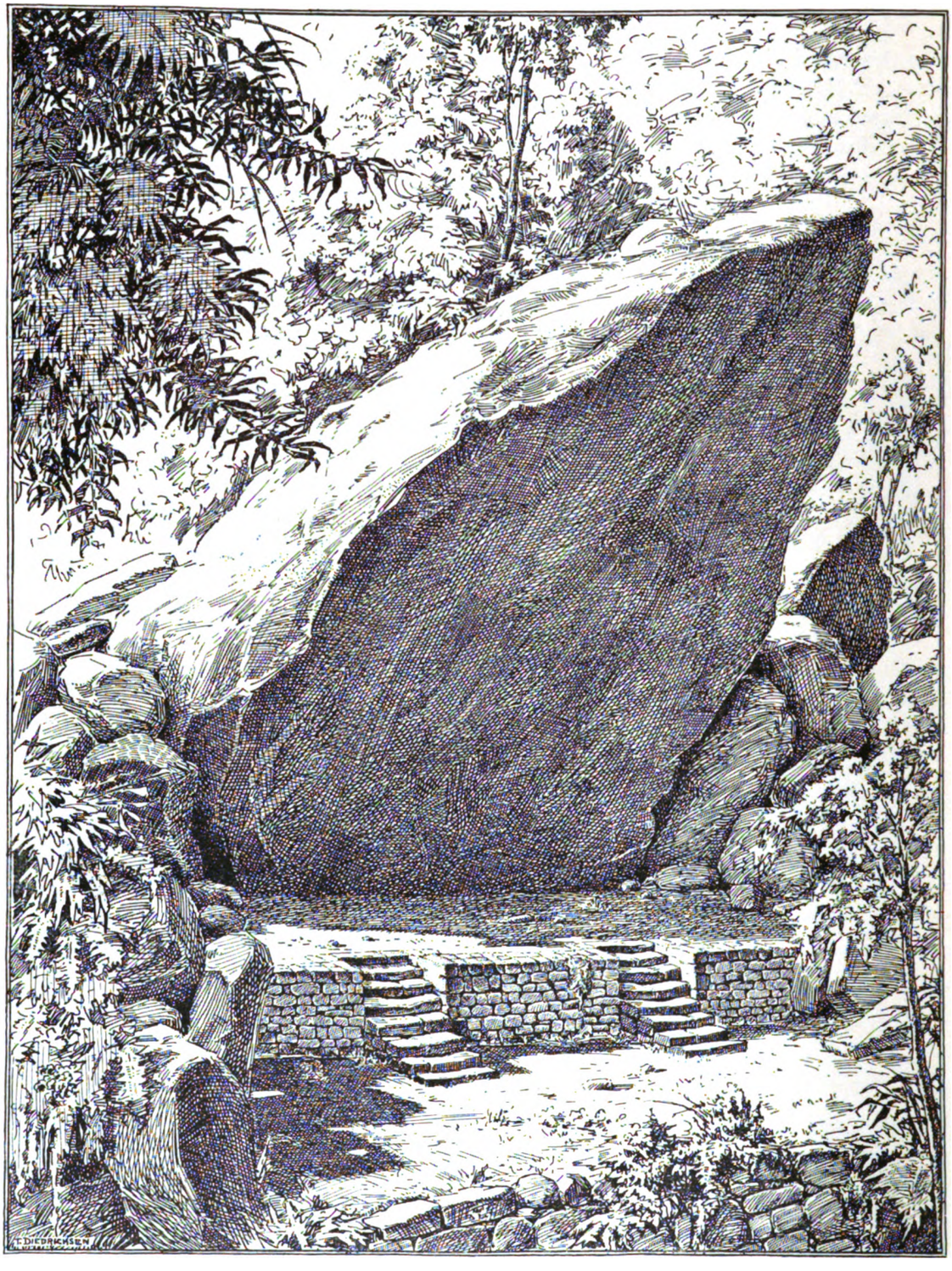

FIGURE 18.—The Rock-sheltered Terrace where Graves 23 and 26 were discovered. Sketch by Mr. T. Diedricksen from material prepared by the author.

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light and apparently female skull were saved. There was considerable charcoal on the floor of the cave, but no bones of food animals and no potsherds. As shown in the illustration, the cave was easily entered, and the pottery, if indeed any vessels had originally been placed there, may have been removed long ago.

Cave 22.

Potsherds were found at the entrance of this cave, but no bones were brought to light, and there was no evidence that an interment had been made beneath the floor. A mummy may have been placed here temporarily and later removed to some other sepulcher.

Figure 19.—Scene during the excavation of the Rock-sheltered Terrace. The Indian assistants Richarte, Fuentes and Alvarez stand in order from left to right in the view. Photograph by the author.

The Rock-sheltered Terrace.

By far the most magnificent place of burial discovered, during our search for graves on the slopes of the Machu Picchu Mountain, was a rock-sheltered terrace southeast of the city and at an elevation about 1000 feet above the highest part of the ruins. This location in what I have termed the upper grave region will be found marked on the map by the serial number 26.

The steep slope of the mountain, protected to some extent from landslides and minor erosion by ancient andenes that had been constructed here, rendered it impossible to take a satisfactory photograph; but the drawing reproduced in text-figure 18, based upon a clay model and rough sketches, will be found to give an essentially correct idea of this remarkable place. The terrace, approached from the next lower andene by two short flights of steps, was about 40 feet long and 15 feet wide. It was almost completely overhung and protected from rain by an immense irregular bowlder, so large as to seem, when first viewed from below, like a peaked crag of the gray granite mountain. The flat-faced

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projecting portion of the bowlder is between 50 and 60 feet in height, and one can make only the wildest estimate of the size of the part that is still embedded in the mountainside. At what prehistoric period the subjects of the Incas or their predecessors in the land took advantage of this unique feature of the mountain to construct a ceremonial terrace beneath its shelter will probably never be known. It is, however, reasonable to suppose that the work could have been accomplished only during the prosperous days of the Inca or pre-Inca periods. No decadent civilization nor any forlorn community of refugees, in daily terror of the conquering Spaniards, could produce results at once so artistic and so grand.

The stately form of the terrace and its construction largely of rock and unfertile gravel preclude its use for agricultural purposes. Facing to the north and sheltered from the fierce noonday heat of the sun, it must have offered an ideal resting place for the Inca and his royal consorts during their visits to Machu Picchu, or at other times for the resident Priests and Priestesses of the Sun and the Mother Superior of the Acclahuasi or House of

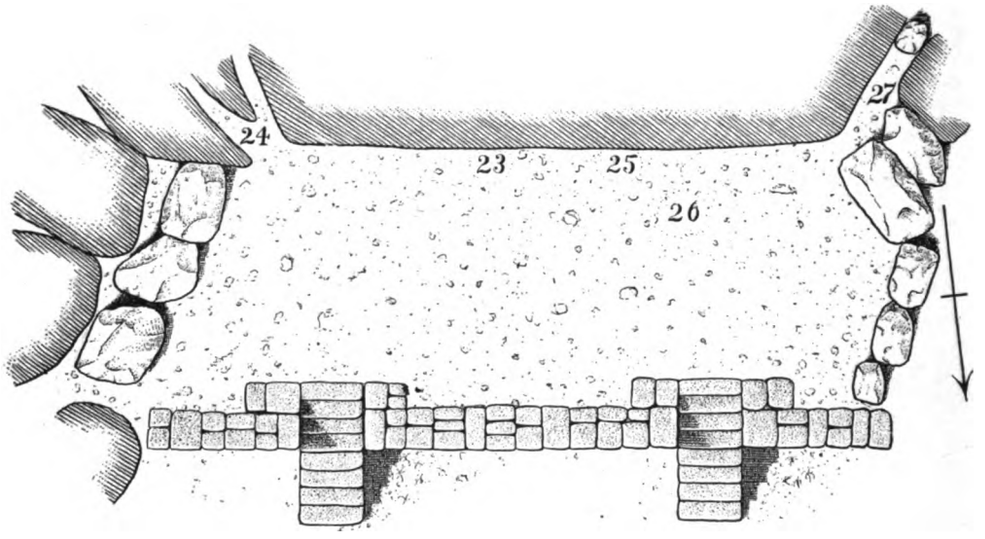

FIGURE 20.—Floor plan of the Rock-sheltered Terrace with locations 23-27.

the Virgins of the Sun. Under these circumstances, it is not surprising that the most interesting burial brought to light during my excavations at Machu Picchu should have been located beneath the floor of this splendid terrace.

On the diagram shown in text-figure 20 are indicated the locations where we found material referred to in this report. Digging into the terrace at the point designated as Grave 23, we found the complete and well-preserved skeleton (Ost. Coll. 3173) of a youth of sixteen years. A few potsherds lay scattered on the surface and in the filling of the grave. These may be pieces of the pottery placed there at the time of the interment, but not enough of them was collected to make their restoration worth while. Considerable charcoal and various fragmentary llama bones were also noted, showing that ample provision had been made for the supposed requirements of the dead. While I have no serious doubt regarding the male sex of this individual, the sexual characteristics of the pelvis are less pronounced than is usually the case in males of this age. As usual all the softer human tissues and all the mummy wrappings had entirely disappeared. In a narrow cleft at the

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southeast corner, marked 24, a small quantity of potsherds was found, together with a few bones of a man and of a llama and some pieces of charcoal. Wedged into the same cleft lay a beautifully finished example of the prehistoric stone-mason's art—a building block with projecting cylindrical stud, designed for the gable end of a house and of the same form as that figured by Professor Bingham in the National Geographic Magazine, April 1913, page 453. Stones of this description were used at Machu Picchu principally for securing the roof-frames of houses, but they may have served other architectural purposes as well. As this gray granite stone had been sheltered from dust and vegetation and everything that might discolor or weather its surface, it looked as fresh and new as if it had been shaped only the day before our visit. On the other hand, the human bones at the bottom of the cleft were so fragmentary and decayed that I could make little of them. They may be the remains of the maker or owner of the building block, but there is no convincing evidence. At the point marked 25, a few potsherds and some miscellaneous bones were seen at the surface; there was, however, no indication of a formal burial.

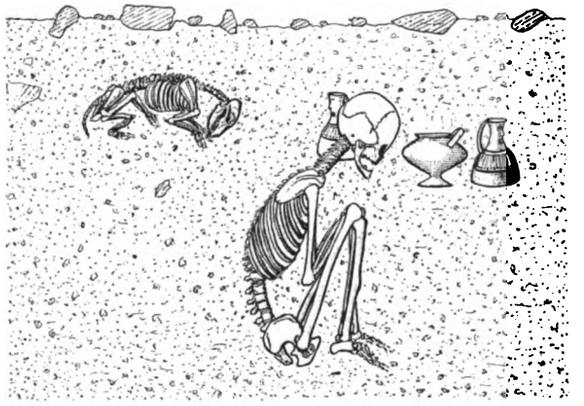

FIGURE 21.—Section of Grave 26 beneath the Rock-sheltered Terrace, showing female human skeleton in the contracted position with pottery and skeleton of a small collie-like Inca dog.

The material excavated from Grave 26, which was about four feet from the face of the bowlder, was attractive enough to arouse the enthusiasm of the most indifferent collector. The position of the human remains and the arrangement of the larger articles placed in the grave are shown in text-figure 21. The skeleton of a delicately formed woman (Ost. Coll. 3175) was found here in the contracted position. Close to her bones were her small personal belongings, her pottery and the skeleton of her dog. This animal (Ost. Coll. 2658) was of a type similar to the Peruvian collie-like Inca dogs, described by Dr. Nehring under the name of *Canis Ingæ pecuarius*. Dogs of this general type, though usually a little smaller than those figured in Reiss and Stübel's Necropolis of Ancon, were frequently seen in the parts of the Cordillera that I visited, and these animals may be largely derived from the ancient stock. At the same time, one should not overlook the fact that the natural tendency of the unrestricted intermingling of some modern varieties would be toward a mixed breed having many of the characteristics of the *C. Ingæ pecuarius*. The modern Indian dogs of this ancient type are very wolf-like, and manifest a most inconvenient fear of the camera. Even when the beast's Indian master, who frequently suffers from the

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same diffidence himself, can be induced to pose with the dog in his arms, the latter will often prove a most elusive and vanishing subject. Although I tried many times, the best dog picture I could secure is reproduced in text-figure 47.

The lady buried in Grave 26 was well provided with personal articles and pottery. Her bronzes and her two plant-spine needles are shown on Plate I, some shreds of woolen and vegetable fabrics on Plate III, figures 15, 16 and 17, and her three very choice pieces of pottery on Plate VI. The catalogue numbers of these articles will be found in the explanations of the plates and therefore need not be quoted here. The only other artifact from the grave is a small problematic object made from a seed (M. P. 775). I have not attempted to figure it. As a rule, long bronze shawl pins similar to those found in this grave are associated with female remains only. Evidence of the lady's careful toilet may

FIGURE 22.—View N.N.W. from the Rock-sheltered Terrace, showing the ruins of Machu Picchu and the cloud-capped mountains of the north wall of the Urubamba Cañon. Photograph by the author.

be seen in the small bronze tweezers, and possibly also in the dainty and minute bronze curette with its ornamental head in the design of a flying bird. It is interesting to note that while Baessler* has applied the general term löffel to a wide range of spoon-like objects including pieces of this class, Wiener† regarded such implements as cure-oreilles. The concave mirror is an interesting object, and may have special significance with regard to the lady's rank and office. A concave mirror is not only more difficult to make than a flat mirror, but is a far less convenient toilet article. A more suitable use is not far to seek. There is a tradition that in the old days of prosperity under the Inca Empire, on certain ceremonial occasions, the High Priestess or Mother Superior of the Virgins of the

* Altperuanische Metallgeräte.

† Pérou Et Bolivie.

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Sun ignited a tuft of cotton on the altar by concentrating the sun's rays with a concave bronze mirror. Whether this can actually be done, I do not know of my own experience. To save matches, a noonday pipe of tobacco can be lighted in a few seconds in these clear altitudes, with a pocket magnifying lens, and a few simple experiments in the tropics with a brightly polished concave mirror would at least be mentally enlightening. Without wishing in any

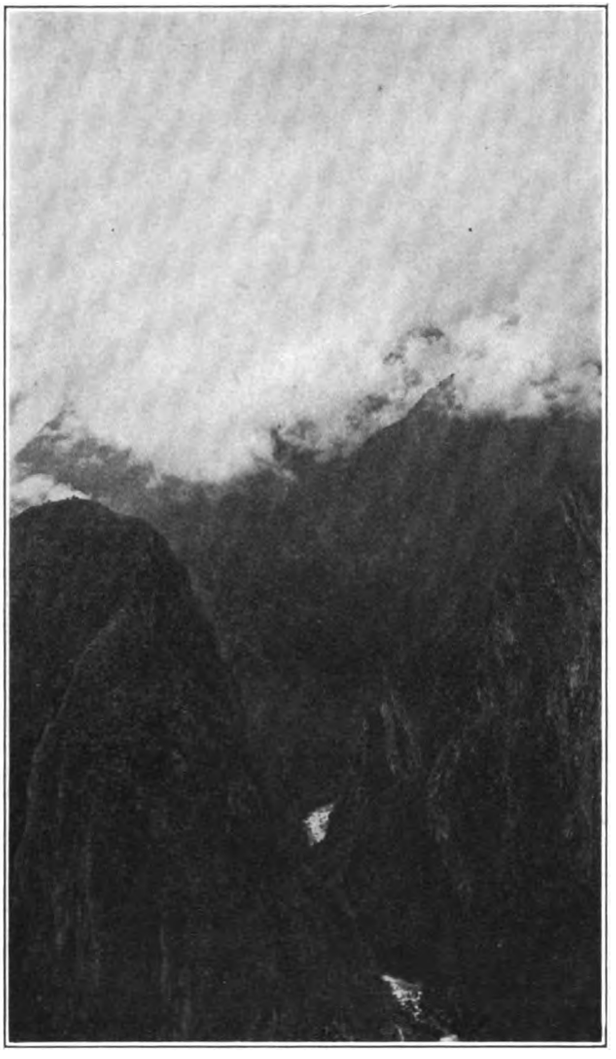

FIGURE 23.—View of the Urubamba Cañon looking N.N.E. (up stream) from the Rock-sheltered Terrace. Photograph by the author.

way to dishonor the Cult of the Sun, one may recall that in many climes and many ages the priesthood has practised minor deceptions upon the laity, in order to arouse or hold the popular enthusiasm. Even if the Priestess failed to ignite the tuft of cotton by the reflected rays of the Sun-God, the holy mystery might have been made to seem very real to the assembled devotees, through a little legerdemain. Whatever the method pursued at the altar,

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I am disposed to recognize the lady with the choice pottery, the collie-dog, the toilet set, and the *handsome concave mirror,* as one who had spent her life and progressed far in the service of the Temple of the Sun.

What grander or more appropriate resting place for her remains, when her service was ended, could have been devised at Machu Picchu than this wonderful terrace, from which,

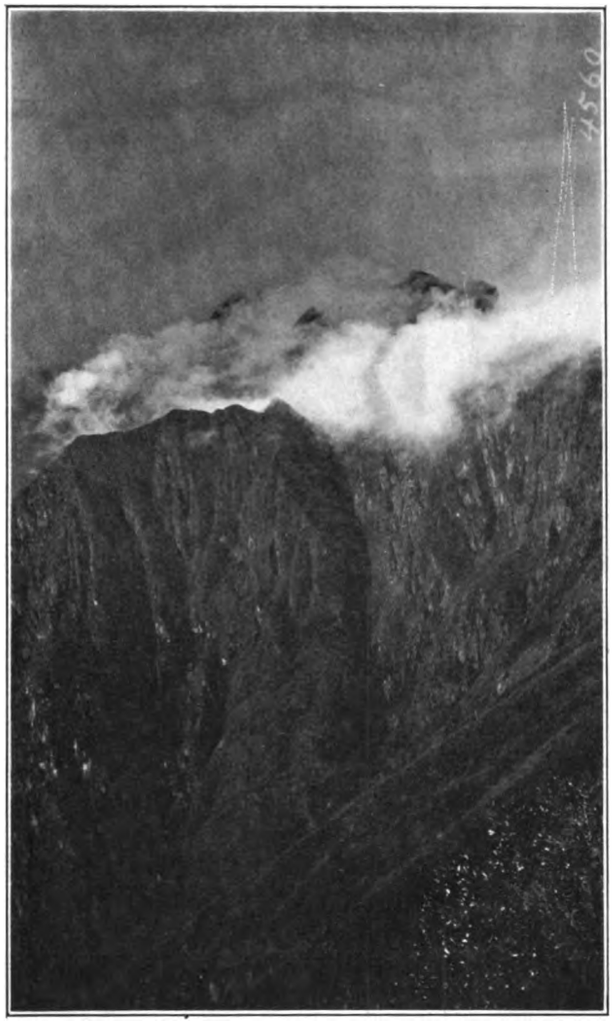

FIGURE 24.—View from the Rock-sheltered Terrace of the mountains to the eastward of Machu Picchu. In the foreground may be seen an old landslide, now covered by vegetation. Many ancient graves may have been destroyed when this part of the Machu Picchu Mountain was swept down into the cañon. Photograph by the author.

before the forest overgrew the andenes, the three magnificent views of city, river and mountains that I have tried to show in the accompanying illustrations were presented to the eye?

The human skeleton (Ost. Coll. 3175) from this grave is of pathological interest. The skull, views of which are shown on Plate XVII, is of an unusual form, yet there is no convincing evidence of voluntary deformation. Although the woman was not past middle-

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age, alveolar abscesses and necrosis of the maxillæ, with loss of several teeth, had brought about considerable alteration in the form of the facial bones, the shape of the lower jaw being almost senile and the zygomata reduced to extreme tenuity. Syphilitic alterations in the femora and tibiæ may be seen in the photographs reproduced on Plate XXXIV, and the skiagrams of these same bones, shown on Plate XXXV, will be found of further interest.

In the recess marked 27, at the southwest corner of the terrace some fragmentary *membra disjecta* of another burial were still to be seen, although it is very likely that native treasure-hunters had already visited the place. The human bones were of practically no value, but a good bone bodkin (Ost. Coll. 3390; Plate IV, figure 11) was found in the recess. In some irregular caves at the east end of the terrace there were a few potsherds, belonging to a large decorated aryballus, and a saucer handle, beautifully modeled in the form of a llama's head.*

Cave 28.

This very small cave in the lower grave region yielded nothing except a worthless sherd of a large vessel and the magnificent aryballus, or "domi" as my Indians called it (M. P. 892), shown on Plate VII, figure 1. Although we dug the ground over in and about this cave, we found neither bones nor any other relics of an interment. Why the fine vessel was there, remains an archæological problem.

Cave 29.

The cave to which this number was assigned was little more than a niche behind an irregular ledge or bowlder, a few hundred feet east of the city. A quantity of broken pottery lay on the surface of the mound of earth thrown out when the place was prepared for the reception of the dead, and many other pieces of pottery were found inside the niche with the skeletal remains of the three persons. The first individual (Ost. Coll. 3176) was an adult woman, whose broad, low-vaulted skull is shown on Plate XVIII. The second individual (Ost. Coll. 3177), also female, had a skull of very different form. From the views of this skull on Plate XIX, it will be seen that the mesaticephalic cranial index of 79.3 is slightly affected by the irregularity of the occipital squama. The third inmate of the cave, a young person about fifteen years of age, was represented by fragmentary material.

The artifacts collected at this place of burial are enumerated in the following list, the first six items being articles that were found inside the cave, while the other four were exposed on the rubble outside. The pottery is shown on Plates VIII and IX.

M. P. 856. Pelike-shaped jug.
M. P. 1012. Two-handled dish.
M. P. 753. Small silver(?) pin.
M. P. 935. Small two-handled dish or olla.
M. P. 830. Ladle or plate with conventional bird's head handle.
M. P. 1080. Beaker-shaped olla.
M. P. 841. Small two-handled dish.
M. P. 887. Pelike-shaped jug.
M. P. 1056. Pot-lid.
M. P. 804. Ladle or plate with loop handle.

* Cf. Hiram Bingham, "The Story of Machu Picchu," Nat. Geog. Mag., Feb. 1915, page 209.

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Cave 30.

From this cave, which was very near Number 29, we collected the skeletons of a woman about thirty years of age and her dog. The human skull (Ost. Coll. 3178) is a very good example of the undeformed oblong highland type. Views of it are shown on Plate XX. The dog was a medium-sized animal of the collie-like breed.

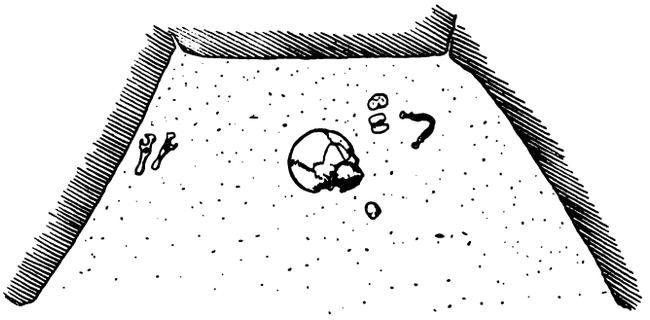

Figure 25.—Floor plan of Cave 30.

Figure 26.—Entrance to Cave 31. Photograph by the author.

The human remains must have been placed in the contracted position as usual, and nearly covered with earth, little more than the head and shoulders being left above ground. The arrangement of the bones, when first seen, is indicated in text-figure 25. The dog, too, seems to have been nearly or quite inhumed. Few potsherds were seen, and no charcoal or bones of food animals.

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Cave 31.

About 1000 feet from the city, and among the irregular bowlders of the northeastern slope of the mountain, we explored the cave shown in text-figures 26 and 27.

Near the entrance, at the point marked A in the diagram, we obtained a nearly complete female skeleton (Ost. Coll. 3179). Views of the skull, a fine example of the brachycephalic coastal type, are shown on Plate XXI. With this skeleton were found a prettily decorated saucer and the upper portion of a large beaker-shaped olla, which is incorrectly outlined in the diagram. Deep down in the earth and small stones at the far end of the cave occurred two more human skeletons (Ost. Coll. 3180 and 3181). Both of these individuals had skulls of the broad coastal type, the latter exhibiting considerable occipital flattening.

With these last skeletons we obtained another small saucer, a medium-sized beaker-shaped olla and the body of a small neatly decorated aryballus.

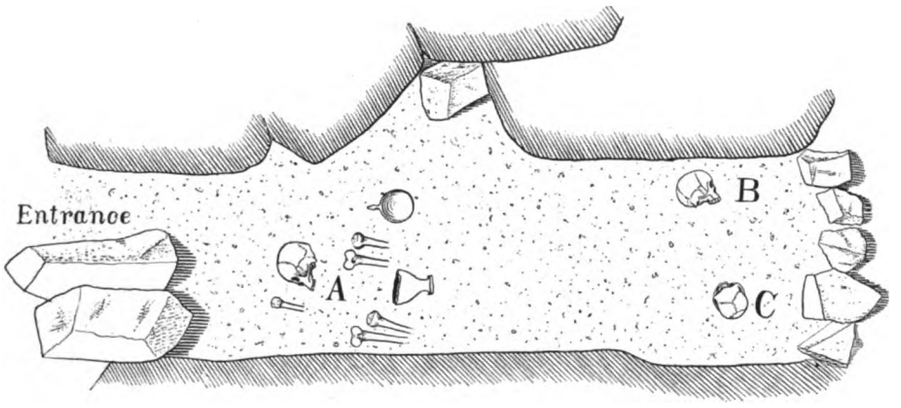

Figure 27.—Floor plan of Cave 31. The skulls at B and C are incorrectly represented as lying on the floor of the cave. In reality they were beneath the surface of the ground.

Cave 32.

Close to the trail leading to our camp from Cave 31, we found a nearly complete adult male skeleton (Ost. Coll. 3182) in the burial place represented diagrammatically in text-figure 28. Although some of the bones were so badly decayed that no attempt was made to save them, the only important skeletal parts lacking were the mandible and left femur. As the threshold of the cave was low, the bones may have been disturbed a little by some marauding animal. Judging from the general appearance of the grave, it seemed highly improbable that this was the work of a treasure-hunter, who, if he removed any of the bones, would be much more likely to take a good skull than the parts that were missing from this skeleton. One should not ignore the possibility of certain parts being broken off and lost, when old, dry and brittle mummies were taken out during ceremonies or removed from one repository to another. The older the burial, the less likelihood of any of the mummy-wrappings being preserved, and as only a few frail shreds of the fabrics used for this purpose were found during the work of excavation at Machu Picchu, we cannot learn how the bodies were attired for burial. It seems almost a pity that a few of the many

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interments in the ancient grave regions of the mountainside did not belong to a period recent enough to admit of the preservation of grave-clothes and mummy-wrappings, down to our own times. The value of the skeletal material, however, is enhanced by these indications of antiquity.

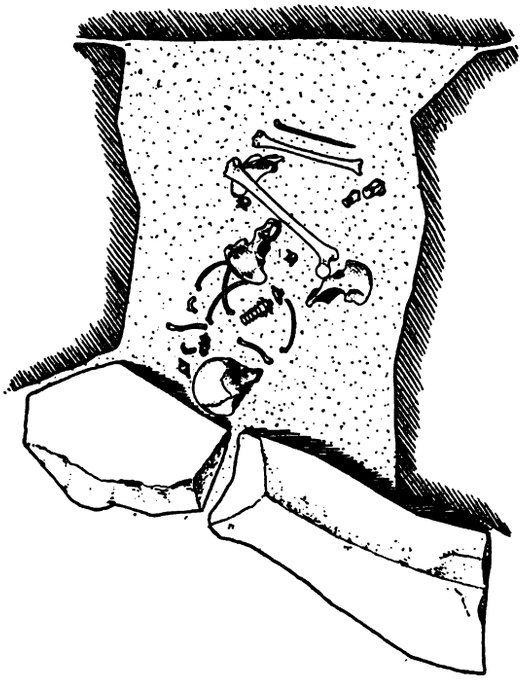

FIGURE 28.—Floor plan of Cave 32.

CAVE 33.

In the part of the lower grave region nearest to the ruins, an open cave shown in text-figure 29 was found to contain a few parts of a large adult human skeleton. The male sex is indicated, although not proved. An odd circumstance that should certainly be recorded, is that neither the skull nor any of the vertebræ and ribs were present, the few skeletal parts that remained being well preserved and lying on the floor of the cave, as indicated in text-figure 30. There were also a few small potsherds of little value, and some broken llama bones that represented the food provided for the dead. No attempt has been made to indicate these in the diagram.

The chief interest in this grave, as in the one immediately preceding, lies in the incomplete character of the human skeletal material. I am disposed to believe that the mummy or at least the greater portion of it had been taken from this grave, leaving only those skeletal parts that would most easily be detached through rough handling. What became of the trunk and skull of this individual, I could not learn while in the field, and when the whole of the osteological collection from Machu Picchu was later carefully examined in the laboratory, only one skull was found that the mandible from this grave would fit—and that skull clearly belongs to a practically complete skeleton!

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FIGURE 29.—View of Cave 33. Photograph by the author.

CAVE 34.

This was a small cave among the large angular rocks, on the slope a little below the ruins. Although it appeared to have been already excavated, we obtained the slightly damaged skull (Ost. Coll. 3184) of a woman about forty-five years of age. The skull is of the undeformed coastal type. The rest of the skeleton was apparently complete, but in a state of poor preservation. As usual the remains had been buried in the contracted position. On the surface of the ground within the cave were strewn some fragments of llama bones, but no pottery was observed.

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Cave 35.

Nothing was collected from this burial place, as the skeletal remains were almost entirely consumed by decay; in fact, the only recognizable parts were a fragment of the cranial wall and the distal end of a humerus. It would not be wise to attribute this decay solely to length of inhumation, as the grave was ill protected from moisture, and conditions were favorable to early destruction of the bones.

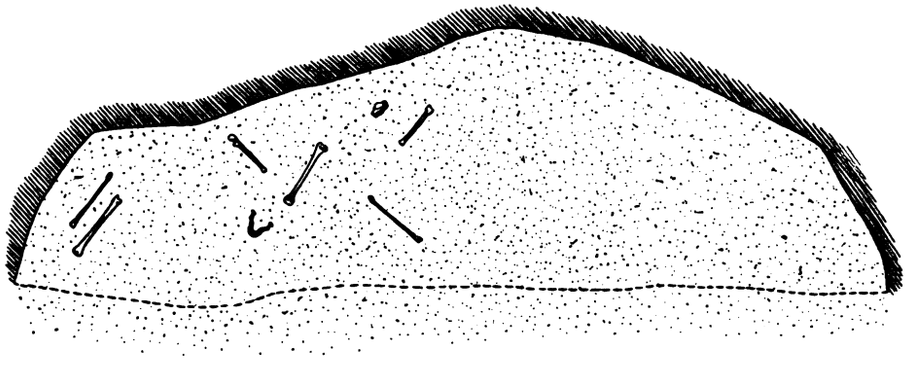

Figure 30.—Floor plan of Cave 33. In this diagram, as in several others, the projection of the sheltering bowlder is represented by a broken line.

Cave 36.

This cave also was in the group of graves a little below the ruins. It contained the osseous remains of a young woman (Ost. Coll. 3185) of the coast. The position of those bones that were to be seen above the ground is shown in text-figure 31. The greater part of the skeleton was concealed within the grave, which had been filled with earth and small stones, up to the shoulders of the mummy. The manner in which the ends of some

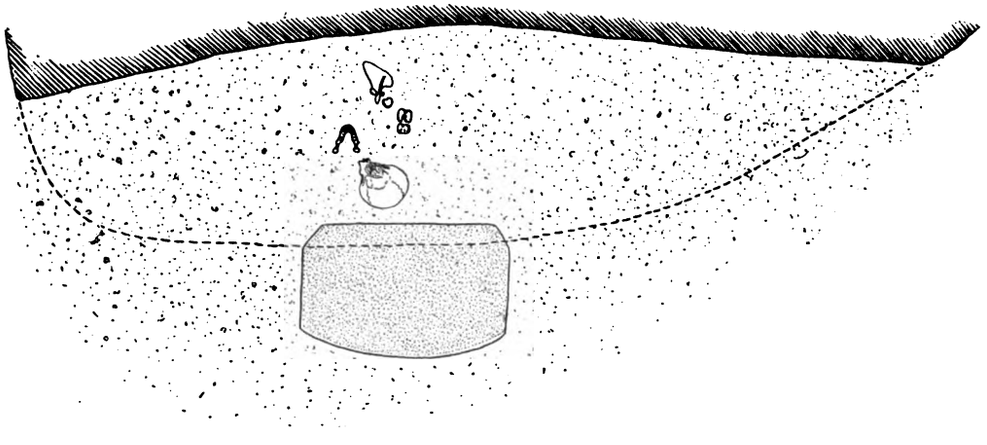

Figure 31.—Floor plan of Cave 36. Close to the bones lay the rocker-edged millstone described in the text.

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of the long bones projected, showed the interment to have been as usual in the contracted position. While excavating the bones, two pins were found, thought to be of silver and of the kind used by ancient Peruvian women to fasten their mantles. Beneath the overhanging edge of the bowlder lay a broken beaker-shaped olla, and a large flat stone supposed at first to be a covering stone of the grave, but later recognized as one of the

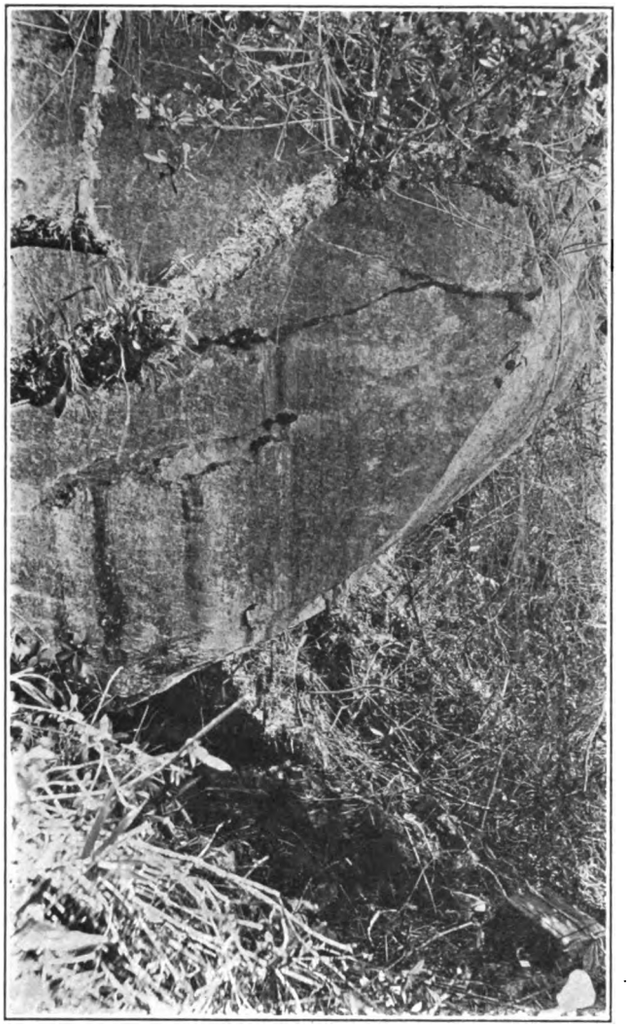

FIGURE 32.—View of Cave 37 from a distance of 25 feet. Photograph by the author.

stones used in ancient times in grinding the ceremonial corn-meal. It was the only instance noted where one of these stones was used to deck a grave at Machu Picchu.

The manner of using the stone is well described by Garcilasso de la Vega,* and need not be quoted here. The important fact to note is that, according to the same historian, bread made from maize was not eaten upon ordinary occasions.

* Royal Commentaries of the Yncas. Translation by Sir Clements Markham. First Part, Eighth Book, Chapter IX.

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"The women of the Sun were engaged, during the night, in preparing an immense quantity of maize pudding called *Cancu*. This was made up into small round cakes, about the size of an apple. It must be understood that the Indians never ate the corn kneaded and made into bread, except at this feast [*Raymi*] and at another called *Situa*, and they did not eat this bread during the whole meal, but only two or three mouthfuls of it at the beginning. Their usual food, in place of bread, was maize toasted or boiled in the grain."*

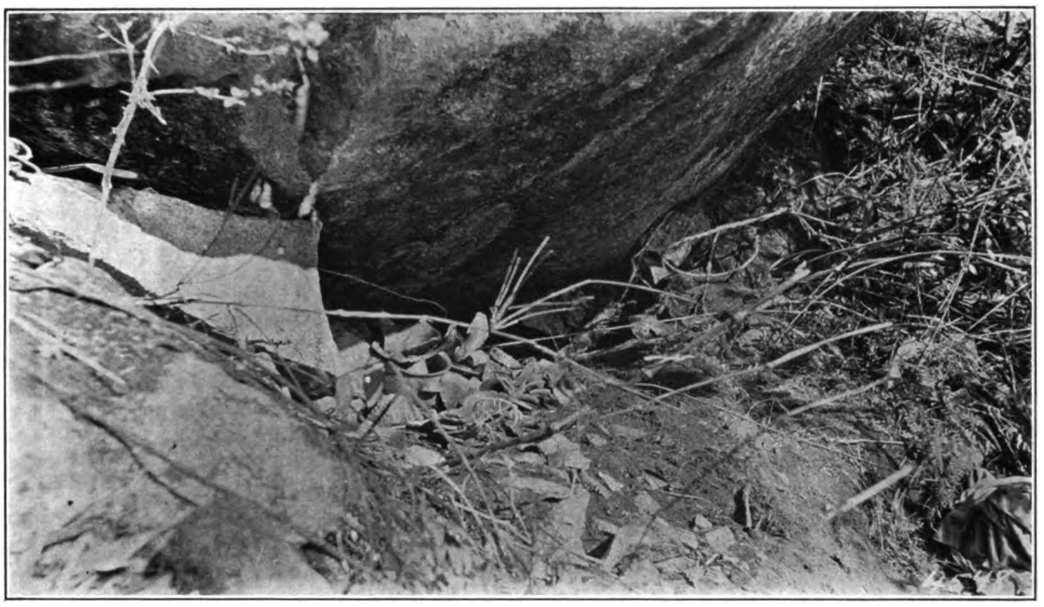

FIGURE 33.—Near view of Cave 37 showing pottery. Photograph by the author.

If Garcilasso's statement applies to Machu Picchu as well as to the places with whose customs he was undoubtedly familiar, the presence of a rocker-edged grinding stone at a woman's grave distinctly favors the supposition that the owner, like many other women whose remains were interred at Machu Picchu, was connected with the service of the Temple of the Sun.

CAVE 37.

In the lower grave region and hardly more than a hundred yards from the ruins, we obtained a splendid lot of material beneath the large rounded bowlder shown in text-figures 32 and 33. To photograph the entrance to a cave from a distance of 25 feet, was an unusual experience. In most places the contour of the mountainside rendered this impossible. Fortunately, in this instance nearly the whole of the exposed portion of the sheltering bowlder can be shown. In the nearer view of the cave may be seen a pile of pottery, most of the vessels being badly broken.

The entrance to the inner cave was small and the interior very dark. With an unpleasant adventure with a Fer-de-lance snake a few minutes before still fresh in my memory, I

* Ibid., Sixth Book, Chapter XX.

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consented to let two of my Indian assistants excavate the pit for me. The first specimens Richarte passed out in his hat were two scorpions. I had not considered the possibility of encountering these!

Next came various parts of three human skeletons (Ost. Coll. 3186, 3187, 3188), including the skulls and pelves, all three adult females, the first two skulls being of the oblong type, while the last was of the brachycephalic coastal type. I willingly accepted and placed on

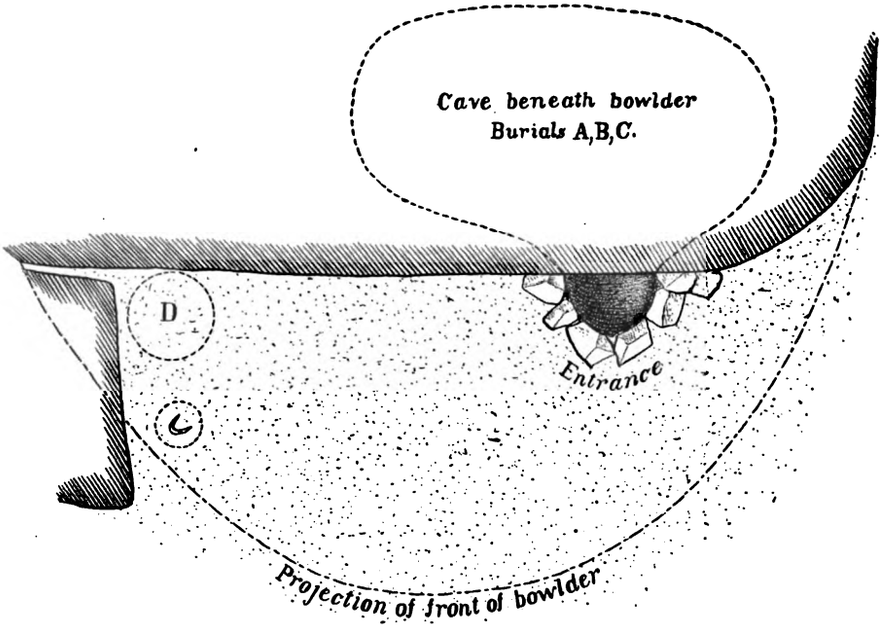

FIGURE 34.—Diagram of Cave 37 to show the inner chamber and outer shelter.

record the Indians' statement that these bones were somewhat scattered in the cave. Several very prettily decorated pieces of pottery were taken from the pit with the three skeletons; also the following metal articles, which are shown on Plate II:

M. P, 754. Bronze ear-pendant?
M. P. 755. Broken bronze needle or pin.
M. P. 756. Silver(?) pin.
M. P. 757. Small bronze tweezers.

At the point marked D in text-figure 34, under the protection of the overhanging bowlder, another grave was found, filled in with earth and stones. This grave contained no skull, but the lower jaw was discovered beneath the surface, about two feet from the rest of the skeleton. Judging from the size and proportions of such bones as were preserved, this individual was an adult female of medium size. The question naturally arises whether this skeleton may not have been removed from the inner cave to make room for the later interments we found there. Although the mountainside is large, we must remember that the number of available burial caves was limited, and it is not at all improbable that mummies so old as to be fairly dropping apart would occasionally have to be set aside.

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FIGURE 35.—The site of Grave 39. Photograph by the author.

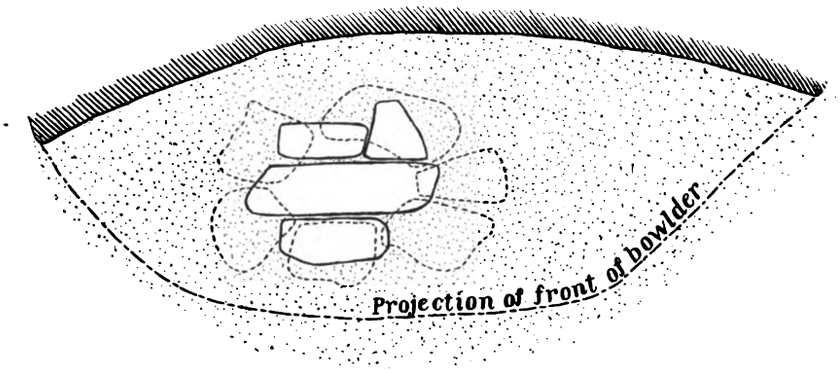

FIGURE 36.—Diagram of Grave 39 beneath a sheltering bowlder. The covering stones of the bottle-shaped grave are represented in solid outline, the next lower tier in broken outline.

The pottery from this cave has since been restored, and comprises, if I am not mistaken, the largest lot of interesting vessels obtained from any one place of burial at Machu Picchu. Some of the pieces are exceptionally fine. As it is possible to show photographs of the entire lot on Plates X, XI and XII, no list of the vessels need be given here.

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CAVE 38.

At the south end of the great bowlder covering Cave 37 was a small shallow niche. Here we found a decayed and fragmentary adult female skeleton (Ost. Coll. 3189), a bronze knife (M. P. 758) and three pins (M. P. 759, 760, 761) of the form used for fastening the women's mantles. Photographs of the knife and pins are reproduced on Plate II. A peculiarity of this cave was that the height under the covering rock was so scant that it could not receive a mummy sitting in the contracted position.

GRAVE 39.

Elsewhere in this report a stone-lined grave in the Sacred Plaza is mentioned. Unfortunately, our party was apparently not the first to search it for booty of one kind or another. For this reason I was especially pleased when, on clearing away the vegetation beneath the bowlder shown in text-figure 35, we came upon the covering stones of a bottle-shaped grave that had been neatly lined with four courses of stonework. The general character of the work can be seen in text-figure 36.

It is astonishing how skeletal parts will retain their relative position if undisturbed in a grave of this description, where a little earth is placed about the mummy or allowed to sift in through the interstices of the lining, and where the innumerable small roots and fibers of tropical vegetation replace the mouldering softer human tissues. Beneath the skull (Ost. Coll. 3190) lay the mandible still in a state of fair preservation, but as the excavation continued downward the bones were found to be more and more decayed. This individual was probably female. Beneath the lower jaw were four oblong pieces of stone, an inch in length, pierced at one end, their position and form indicating that they were originally strung as neck-pendants. The dark soil went down a little more than half the depth of the grave; below this level the fine reddish earth of the mountainside had been filled in around the contracted remains. On the surface of the ground in front of the grave lay a number of potsherds. It is interesting to record that several pieces of a deep two-handled dish (M. P. 937) were found at a depth of one foot, in the ground behind the grave, the rest of the vessel being on the surface in front. In all probability, this vessel was part of the garniture of an earlier burial under the sheltering bowlder, and a broken portion of it was covered at the back of the shelter or cave when the grave excavated by our party was dug. This again is evidence that burials were made at different periods in the caves of the Machu Picchu Mountain. Another vessel, restored from *eighty-one* sherds since the return of the Expedition, is a very large dark-brown fire-blackened beaker-shaped olla (M. P. 1077).

GRAVES 40, 41, 42 AND 43.

Under a great overhanging flat bowlder of the lower cave region, the remains of several individuals were found in locations to which for convenience of reference these four numbers have been assigned. As will be seen in text-figures 37 and 38, these locations should perhaps be regarded as one grave. I am also inclined to think that the bones of some of the individual skeletons had been slightly misplaced or mixed by previous visitors.

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At location 40, the remains of two adult women (Ost. Coll. 3191 and 3192) and one infant lay on the sloping surface of a broad shelf of rock, where the mummies had probably rested in the contracted position until decay of the softer tissues and the wrappings caused the bones to fall apart. The first of these individuals was a woman of the mountain type, about twenty-five years of age; the other woman was older and her skull exhibited the

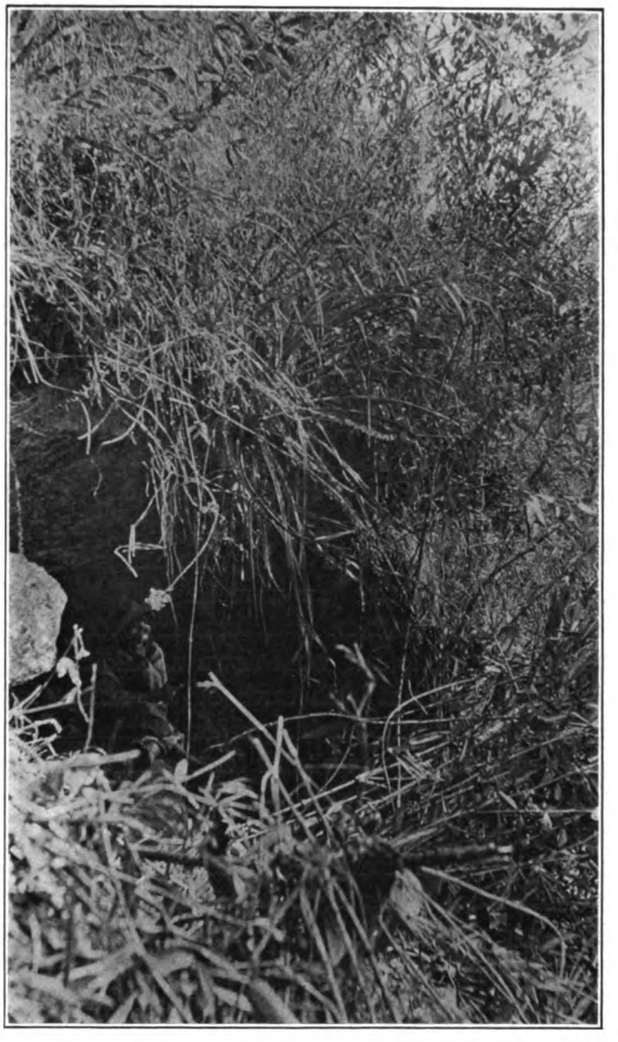

FIGURE 37.—View of the entrance to the large cave with locations 40-43. The Indian is Alvarez. Photograph by the author.

pronounced fronto-occipital flattening of the coast. In the foreground of text-figure 39, a femur and tibia of this individual may be seen, still united by some of the dried tissues of the knee-joint. A curious incident occurred with regard to these bones. My Indians Alvarez and Richarte begged a few shreds of the desiccated muscle-fiber which, as they seriously informed me, they intended to add to the ordinary contents of their ollas for

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"buen fortuna." They even advised me to do the same. Although keenly interested in this survival of an ancient savage superstition, I need hardly add that I abstained from acquiring the courage and virtues of the aborigines in the time-honored manner.

The infant mentioned above was probably less than a year old. Very little was left of its skeleton. A plant-spine pin and a few potsherds were the only artifacts collected at this location.

At location 41, the greater part of two adult skeletons (Ost. Coll. 3194 and 3195) were found, together with the facial portion of the skull of a young person about fifteen years of

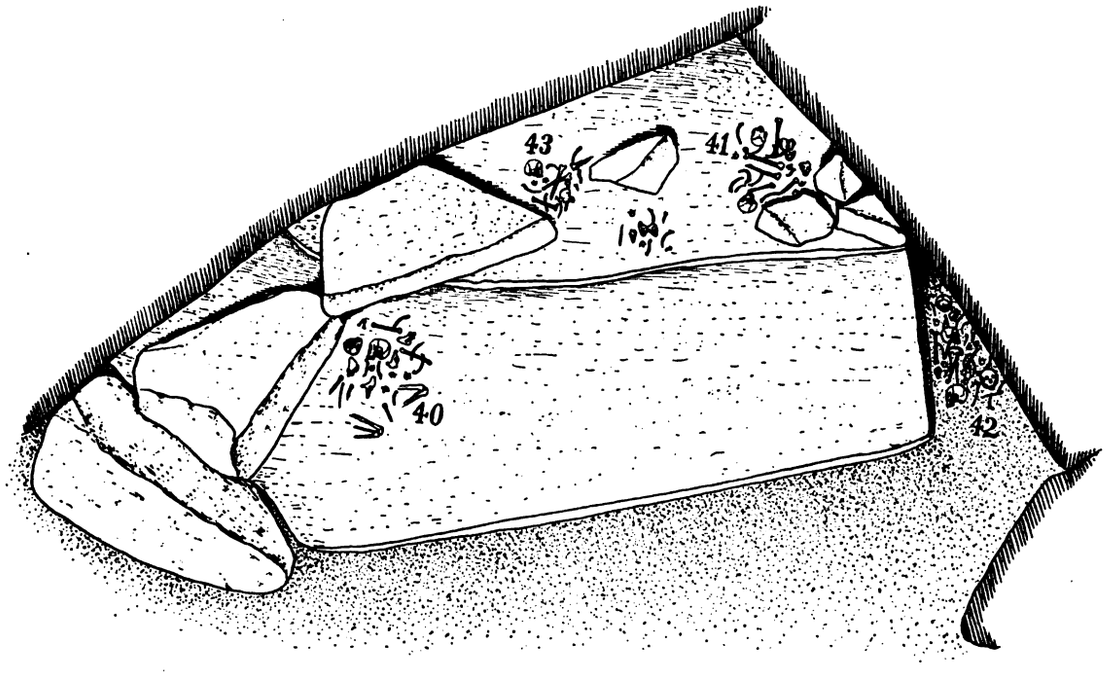

FIGURE 38.—Plan of the large cave with locations 40-43.

age. The skull of the first individual might pass for female had not the pelvis been found. It is a small male skull of the undeformed highland type. The other adult individual appears to have been a woman of the coast.

In the narrow recess marked 42 on the diagram lay the fragmentary remains of five individuals. Four of the skulls (Ost. Coll. 3196, 3197, 3198 and 3199) were fairly well preserved. The first of these skulls, probably male, is shown on Plate XXII. The other skulls are female, two of them being of the undeformed coastal type, while the third (Ost. Coll. 3199) is a typical example of the Aymara deformation. Several views of it are shown on Plate XXIII. The fifth skeleton may represent a much older burial. Very little of it was preserved.

At location 43, on the topmost shelf of the cave, we found an adult female skeleton (Ost. Coll. 3200). The highly brachycephalic cranial index of this skull is partly due to a slight accidental lateral-occipital flattening, such as frequently resulted from the use of the cradle-

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board, even when no pressure was intentionally exerted on the forehead. With this skeleton, the sherds of a two-handled dish were collected.

Graves 44, 45 and 46.

These locations, about 800 feet north of the ruins, were beneath the very attractive rock-shelter shown in text-figure 41. The under surface of the bowlder is flat, and about 15

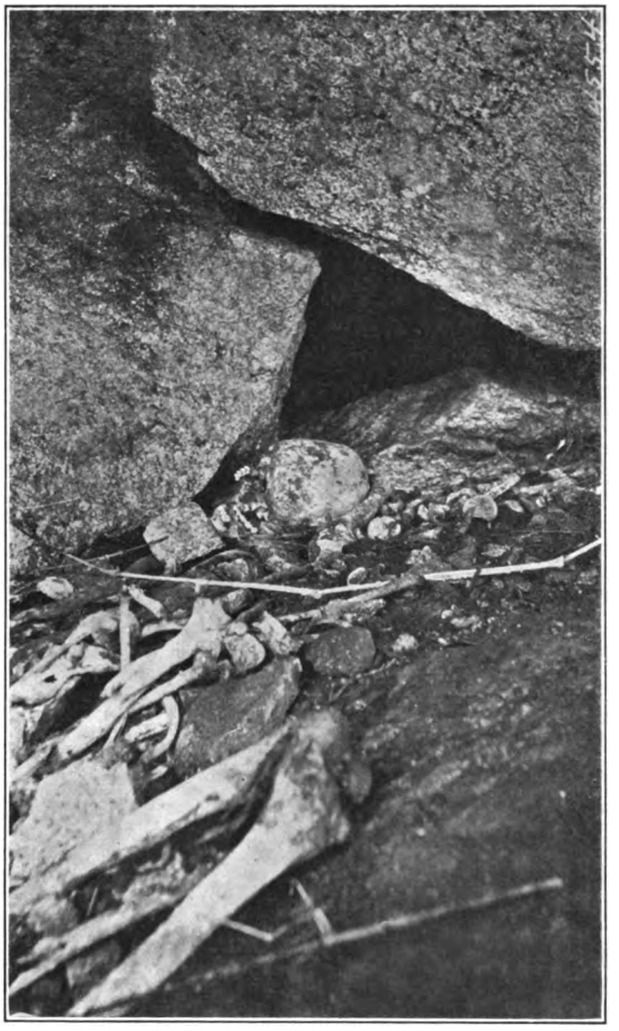

Figure 39.—View of human bones at location 40. A femur and tibia, still united by dried tissues, are seen in the foreground. Photograph by the author.

feet long and 10 feet wide. The relative position of the locations is further explained by text-figure 42. To my great surprise, the cave designated as Grave 44 contained not a single bone nor potsherd. At location 45, we were more successful. Excavating at this point, a poorly preserved skeleton was found, probably female, though the sex is doubtful. Inter-

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ment had been made in the contracted position. The only artifact taken from the grave was a pair of very broad-edged bronze tweezers (M. P. 764).

Grave 46 also yielded a badly decayed female skeleton. The arrangement of these bones in the grave suggested the possibility that this was not an original burial. No artifacts

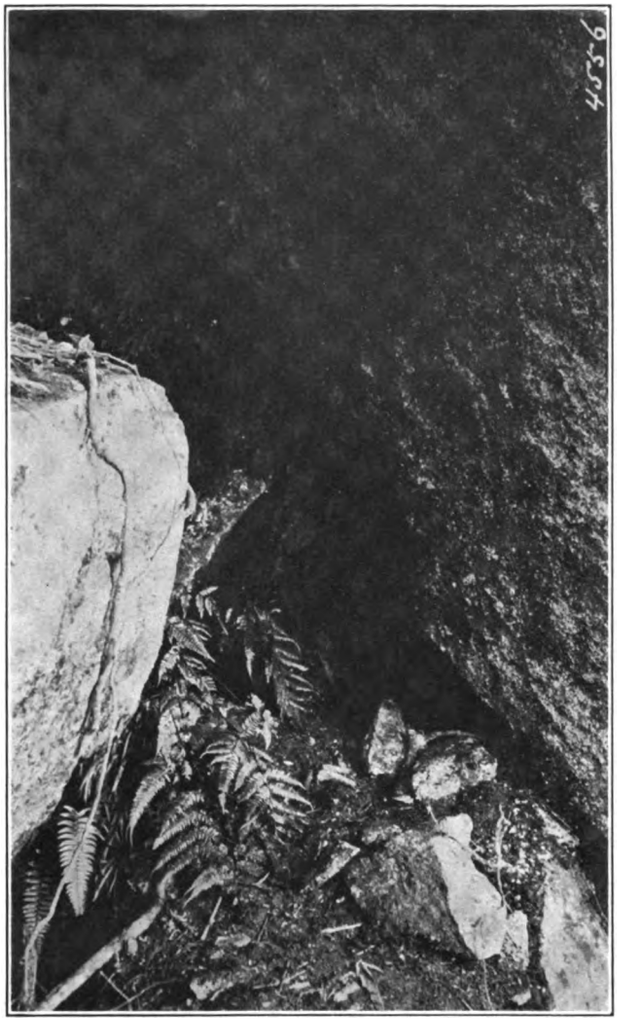

FIGURE 40.—View of location 42 before excavation. Photograph by the author.

were seen in this grave. The purpose for which the low stone walls were constructed is not clear.

CAVE 47.

One of the most remarkable burial places that we discovered in our search for graves at Machu Picchu was the unique three-storied cave shown in text-figures 43 and 44. This was near Cave 46.

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In the first and highest of the three communicating chambers, at the location marked A in the diagrams, we found the skeletal remains of a woman (Ost. Coll. 3201) and a child (Ost. Coll. 3202). The woman was about thirty-five years of age and of the highland type. As the child was only six years of age, the dolichocephalic form of its skull has little racial significance.

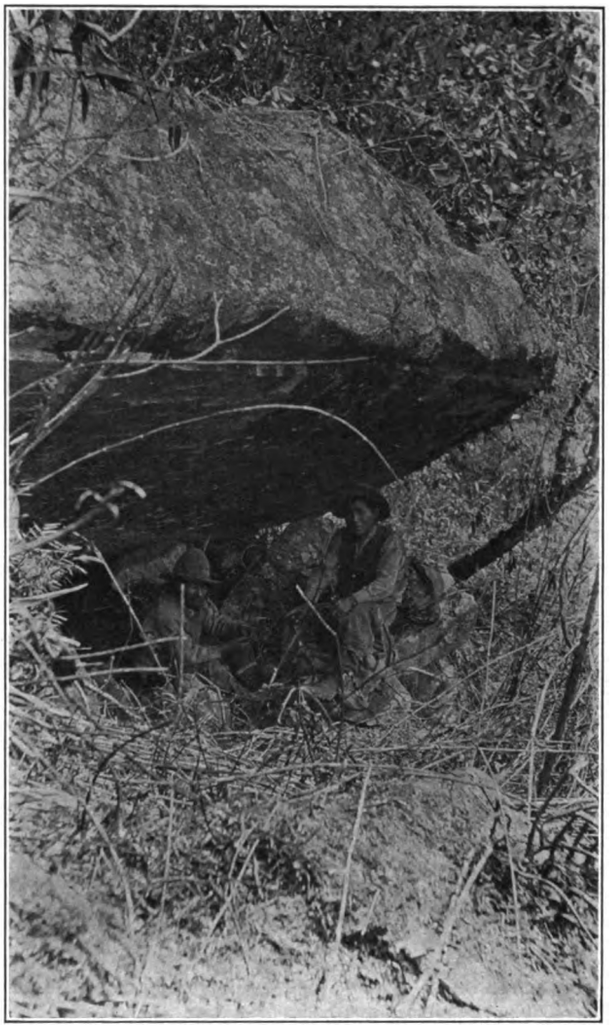

FIGURE 41.—View of the rock-shelter above Graves 44, 45 and 46. The Indians are Alvarez and Richarte. Photograph by the author.

In the second chamber (B) lay the bones of a young woman of the highland type (Ost. Coll. 3203), another skeleton supposed to be female, with fragmentary skull, and a quantity of potsherds. In the third or lowest chamber (C), which was not nearly so dry as the other chambers, we found a badly decayed female skeleton and many more potsherds. When

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the pottery from the caves was examined and restored, it appeared that pieces of the vessels placed in chamber B had fallen into chamber C. The entire list of pottery is as follows:

M. P. 807. Ladle or plate with flat-topped mushroom handle. In perfect condition.
M. P. 839. Two-handled bowl.
M. P. 872. Two-handled dish.
M. P. 934. Two-handled dish.
M. P. 843. Very small two-handled dish.

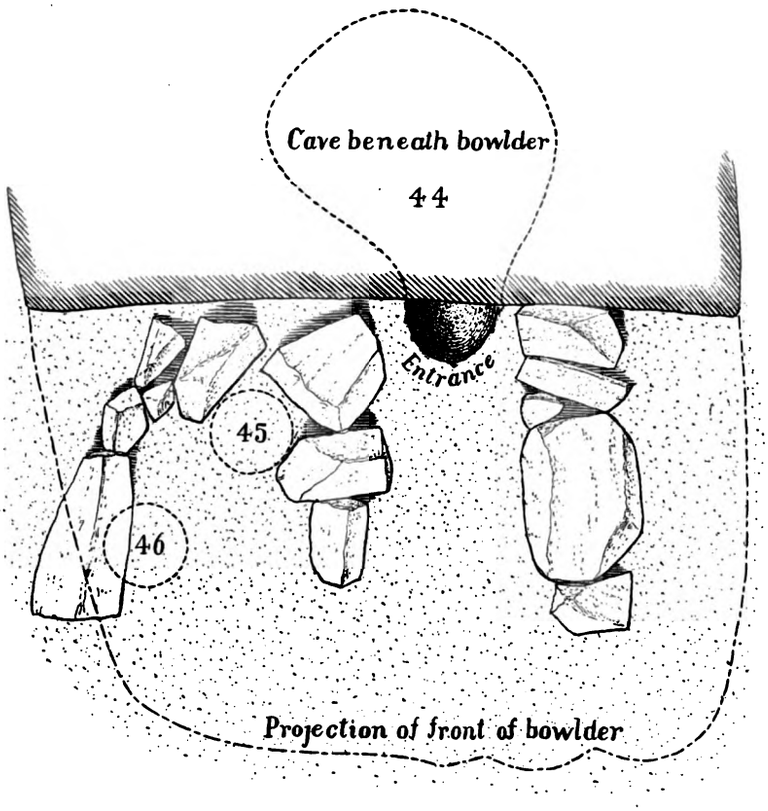

FIGURE 42.—Plan of Graves 44, 45 and 46.

CAVE 48.

There was nothing remarkable about the form of this burial cave beneath a bowlder on the same part of the mountain as the three-story cave. It did, however, yield some very good material. Two human skeletons were found. Judging from the characters of the skull and other bones, the first (Ost. Coll. 3204) is probably male, but the sexual determination is not positive, as the pelvis was very poorly preserved. The skull, however, which is quite free from deformation, appears to be that of a small man of the coastal type.

The other skeleton is that of a young woman hardly more than twenty years of age, the basial suture not being entirely closed. The form of the skull is oblong. No pottery was found in this cave.

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Llama meat seems to have been provided for the needs of the two persons buried in this grave, but the provision was not over generous, judging from the indications afforded by the distal end of a humerus and one phalanx, which were all the llama bones that were found. The human bones were scattered about the cave, and it was noted that the proximal ends of the femora and the distal ends of the tibiæ and fibulæ were most decayed, showing that the mummies had originally been placed sitting in the contracted position. With regard to the human skeleton, No. 3204, as in other cases coming to our attention, the absence of the mandible may be the result of temporary removal of the mummy from the cave for ceremonial purposes.

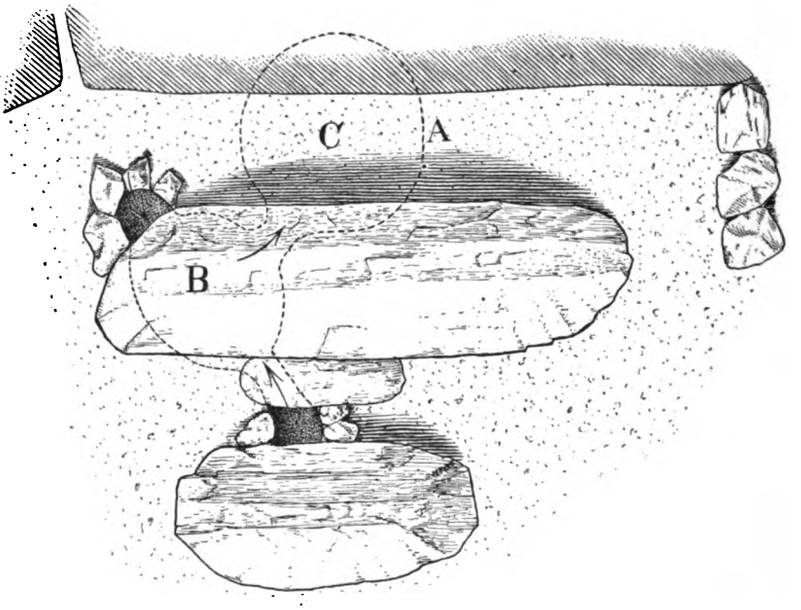

FIGURE 43.—Horizontal plan of the Three-storied Burial Cave 47.

The pottery found in this cave included a beaker-shaped olla (M. P. 961) and a diota-shaped pot (M. P. 936).

CAVE 49.

This cave was in the upper grave region not far from the Rock-sheltered Terrace. It contained the skeleton of a woman about twenty-five years of age (Ost. Coll. 3206). The undeformed skull is of the coastal type. From the manner in which the long bones are affected by decay, it is evident that burial was in the contracted position.

CAVE 50.

This cave was located beneath a large bowlder not far from the huts occupied by my Indian assistants, who posed at the entrance while the photograph reproduced in text-figure 45 was taken.

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The greater portion of the three fragmentary human skeletons lay scattered upon the floor of the cave, which was formed partly by the overhanging bowlder and partly by rough stones of varying sizes that had been rolled in so as to cut off the view from the sides of the cave.

The first skeleton (Ost. Coll. 3207) was that of an adult woman of the highland type. Practically all the basal portion of the skull was missing, the line of fracture from the lower parts of the temporal squamæ through the lambda being almost as straight and even as if the skull had been artificially sectioned.

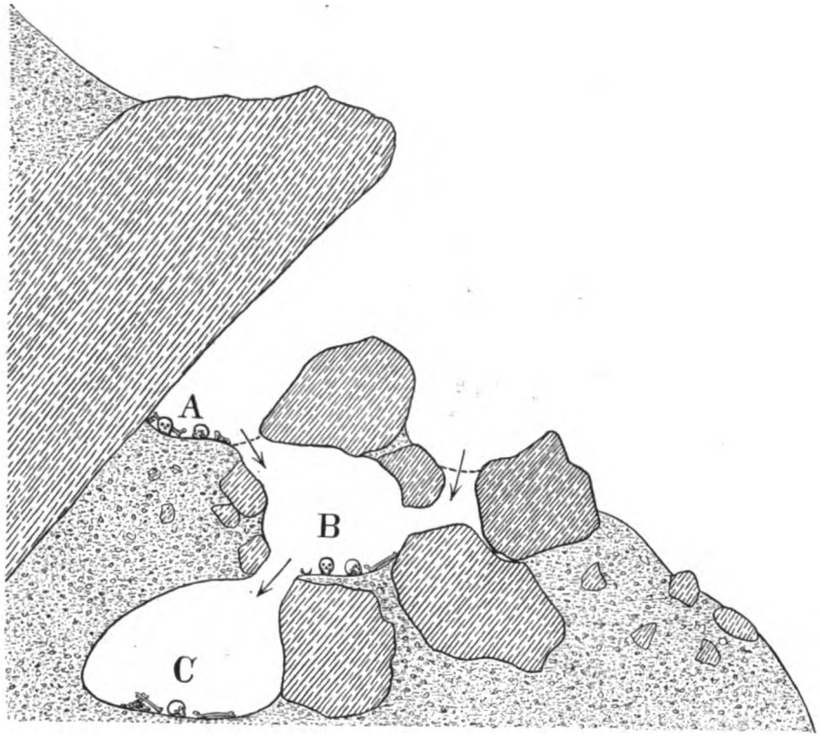

FIGURE 44.—Vertical section of the Three-storied Burial Cave 47.

The second skeleton (Ost. Coll. 3208) was that of a child about twelve years of age. Fragments of the pelvis indicated the female sex.

The third individual (Ost. Coll. 3209) was an adult woman, the pelvis showing unmistakable female characters. The left tibia presents a small localized node on the anterior aspect.

The fractured surfaces of the broken bones of these three skeletons appear as weather-beaten as the natural surfaces, a circumstance indicating that injuries to the skeletons are very old, some of them perhaps the effect of fatal accidents. From the examination of dry bones, it is generally impossible to distinguish posthumous injuries from those that were immediately or soon followed by death.

No bones of lower animals representing provisions for the dead were found here, nor any bronze articles nor pieces of pottery, with the exception of one small sherd. Whether

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to attribute this dearth of grave garniture to indifference on the part of surviving friends, to poverty, to removal of the remains from another place of burial, or to the grave having been previously plundered by treasure-hunters, I do not know. The cave was only about one hundred yards from the hut of Alvarez, one of my Indian assistants, but until recently it had been hidden from view by a thick jungle-growth, which our party burned. I am confident

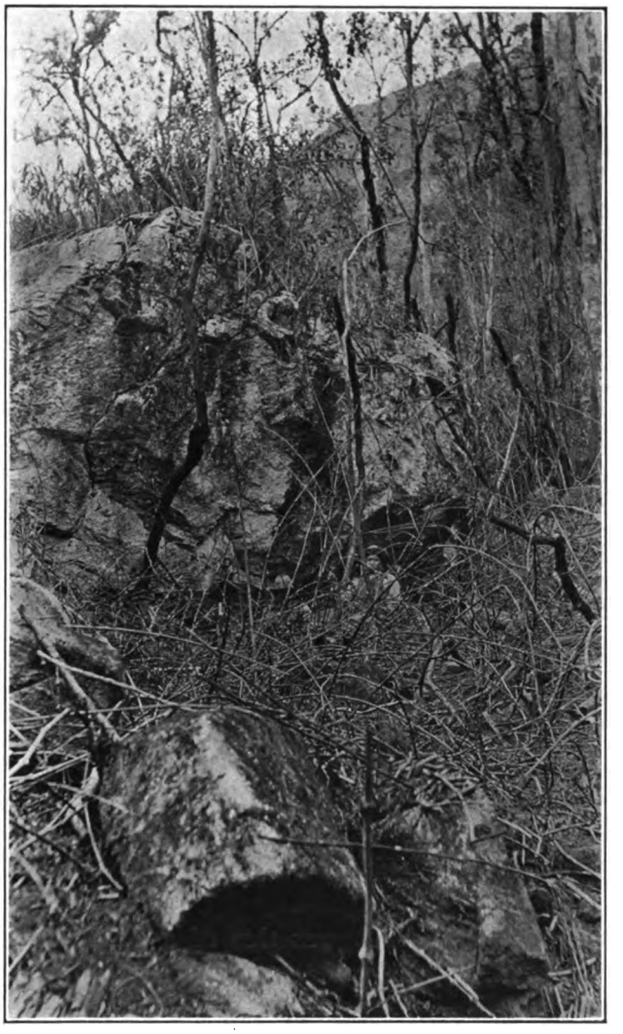

FIGURE 45.—View of the entrance to Cave 50. Photograph by the author.

that none of the Indians living at Machu Picchu in 1912 knew of the cave until the day of excavation. Alvarez, moreover, had a strong superstitious dread of incurring trouble through his sacrilegious labors as my fellow grave-robber. This trait appeared in various ways, and was so marked that on one occasion, when a latent malady manifested itself in a severe and painful relapse, probably brought on by a rash excess *in vino et Venere*, he insisted that the disease was visited upon him in retaliation by the malevolent spirits whose

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sepulchers he had desecrated. Ultimately the lavish rewards offered for attractive "finds" brought him back with lagging footsteps to the unholy but profitable quest.

Cave 51.

This was a natural cave of several chambers formed by a group of large irregular rocks. Of ample size for sheltering many mummies, as may be seen from the accompanying view, it was accessible from the city without the hardship of a long or difficult climb on the mountainside. It was accordingly a matter of no little surprise to find that it contained the

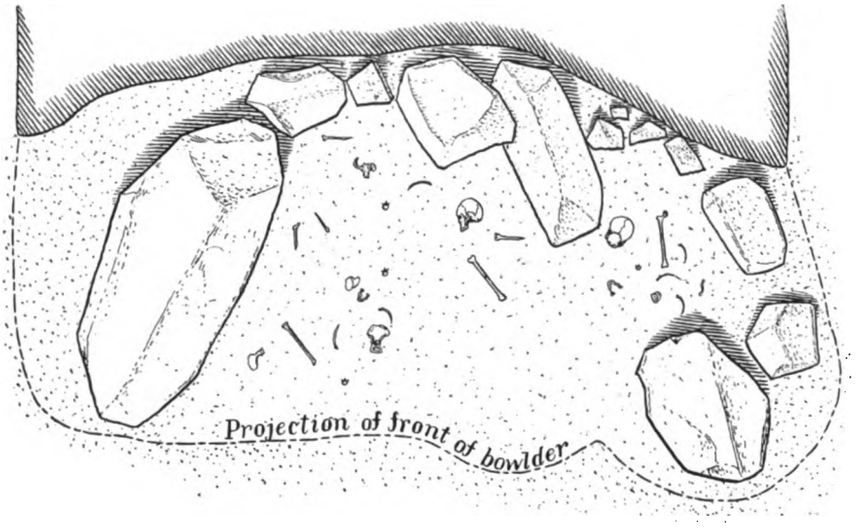

Figure 46.—Floor plan of Cave 50.

remains of only one individual—a child of about seven years of age (Ost. Coll. 3210). No pottery was found and no bronzes. In fact the only article obtained here, other than the human bones, was the mandible of a young llama. Here again, in providing for the supposed food-requirements of the deceased, it seems at first as if the local conventions were satisfied by the donation of about as unattractive and little nourishing a portion of an animal as could have been selected, yet it by no means follows that no other food than that represented by the jaw of a llama was provided. The difficulties of quartering a carcass and especially of cutting apart or breaking the bones before the removal of the flesh would be considerable to anyone working only with primitive bronze and stone tools. Pieces of llama flesh carved from the bones would be much easier to provide than severed and broken bones with flesh adhering, and it is reasonable to suppose that boneless rations of this sort may often have been provided, in addition to fruits, maize, potatoes and other vegetables. It is known that medium-sized dogs of the sheep-dog or wolf-like type were kept by the ancient Peruvians. Such animals are inveterate prowlers, always hard to restrain from foraging for themselves, even in civilized communities where fences and doors are common. Unless a burial cave or grave were closed or protected, what was to hinder domestic dogs or wild carnivores from entering, and carrying off any flesh that had been left there? In fact

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it is difficult to understand how these animals could have been prevented from molesting *human* remains newly placed in open caves. I think the explanation lies in the probability that at first the bodies were not thus exposed. If originally placed in caves, they may have been protected from marauding creatures by barricading or stoning up the entrances, in the manner observed in several of the Machu Picchu graves, until the natural process of desiccation or mummifying was completed. Or the bodies in suitable mummy-sacks may have been kept for a time in certain buildings, many of the niches or false windows of the walls being of ample size for this purpose.

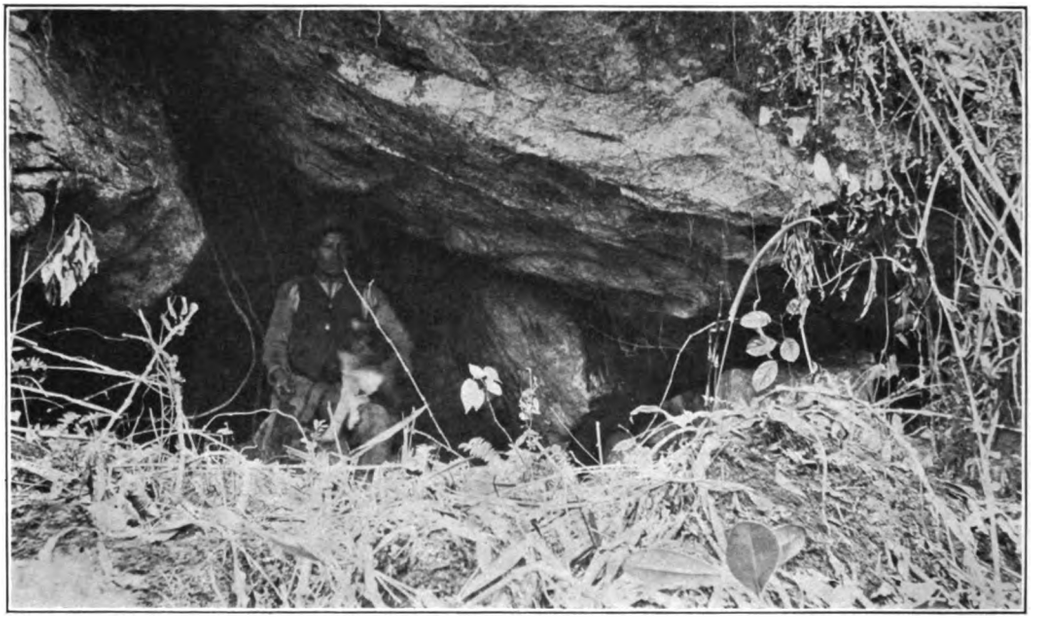

FIGURE 47.—View of Cave 51 with Richarte and his dog. Photograph by the author.

In the vicinity of Machu Picchu, it would not seem necessary to make use of any embalming substance in order to render the near presence of the dead bodies endurable, especially if the viscera were removed, for the rapid desiccation of the tissues would prevent any overpowering odor. In support of this view I would refer to the custom in this part of the mountains, of preparing *charqui* or cured meat by merely exposing flesh to the air, on pergola-like structures raised above the height to which a dog can leap. The process of curing is so little mephitic that on a cool night the belated traveller can sleep beneath the partial shelter of one of these structures, unhaunted by visions of

> "un horrible mélange
> D'os et de chairs meutris, et trainés dans la fange,
> Des lambeaux pleins de sang, et des membres affreux
> Que des chiens dévorants se disputoient entre eux."

And if on the morrow, he breaks his fast upon broth made from pieces of the strong-flavored leathery product, generously seasoned with native herbs, he will experience no unpleasant after-effects.

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The skull and lower jaw (Ost. Coll. 3210) of a child about seven years of age, from this grave, are chiefly interesting pathologically, the destructive process of inflammatory disease having resulted in two perforations of the frontal bone. Views of this skull are shown on Plate XXIII, figures 1 and 2. One lesion is situated low on the frontal, a little to the left of the mid-line, and the other on the right near the coronal suture. In both these lesions the destruction of the inner table has advanced widely beyond the limits of the perforations; in fact the two lesions are thus connected endocranially. There is also to be noted a similar destruction of the inner tables of the parietal bones along the anterior part of the sagittal suture.

Of the rest of the skeleton, a few fragments of decayed long bones, cervical vertebræ and podials were all that could be saved. None of these fragments or the lower jaw exhibited any signs of disease.

Cave 52.

The cave or place of burial designated by this number was at the foot of an overhanging crag or bowlder, the projecting portion of which was about 30 feet long and 20 feet high. Low side walls constructed of large irregular rocks were continued around to and along the front, so as nearly to enclose an area that was roughly floored off with pieces of rock of various sizes up to about 75 pounds in weight. On entering the cave no bones, either human or of lower animals, were visible. A few potsherds of little value and a six-faced hammer-stone (M. P. 1887) were the only articles exposed on the floor of the cave. The individual graves were beneath the floor and approximately at the locations denoted in the accompanying diagram by the letters A, B, C, D and E. As was usually the case where the remains had been actually *interred* or buried in the ground, most of the skeletons were sadly decayed, the vertebræ and pelvic bones especially being so poorly preserved that but little could be saved. The long bones of the lower limbs were nearly upright in the ground, in most instances the proximal ends of the femora and the distal ends of the tibiæ and fibulæ being disintegrated, while the ends of these same bones articulating to form the knee joints were much better preserved, because they rested nearer the surface and in dryer ground. This seems to have been almost invariably the case where human remains were buried with the knees raised in the contracted position. The depth of these graves was such that the skulls which were in place with reference to the rest of the skeletons were found from 15 to 18 inches below the floor of the cave.

The human skeletal material obtained from this cave is as follows:

Skull and jaw (Ost. Coll. 3211), female (?), with long bones (most of them fragmentary), including the femora, tibiæ and humeri. The skull is not entirely female in its characteristics, being a trifle coarse in type. but the femora that accompany it are well within the range of female variation and could hardly be regarded as male. The same is true of the humeri.

A few fragments of the pelvis, not serving to determine the sex, yet very light and apparently female.

Skull (Ost. Coll. 3212), male, showing Aymara deformation. The skull, however, is defective; the entire facial portion with part of the frontal is gone, the fractured edges of the bone indicating a very old injury, though it is not clear that this was posthumous.

The long bones of this skeleton were badly decayed and were taken out in fragments. The interment was in the contracted position.

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A fragment of a female skull (Ost. Coll. 3213) with the lower jaw shows slight Aymara deformation, and has an incomplete Inca bone. The rest of the skeleton was almost entirely consumed by decay.. A chicha jug, with a grotesque fat man modeled in relief on the neck (Plate XIII, figure 4), was found buried close to the skull. Alvarez, one of my Indians, while excavating at random, lightly drove the point of a small combination pick

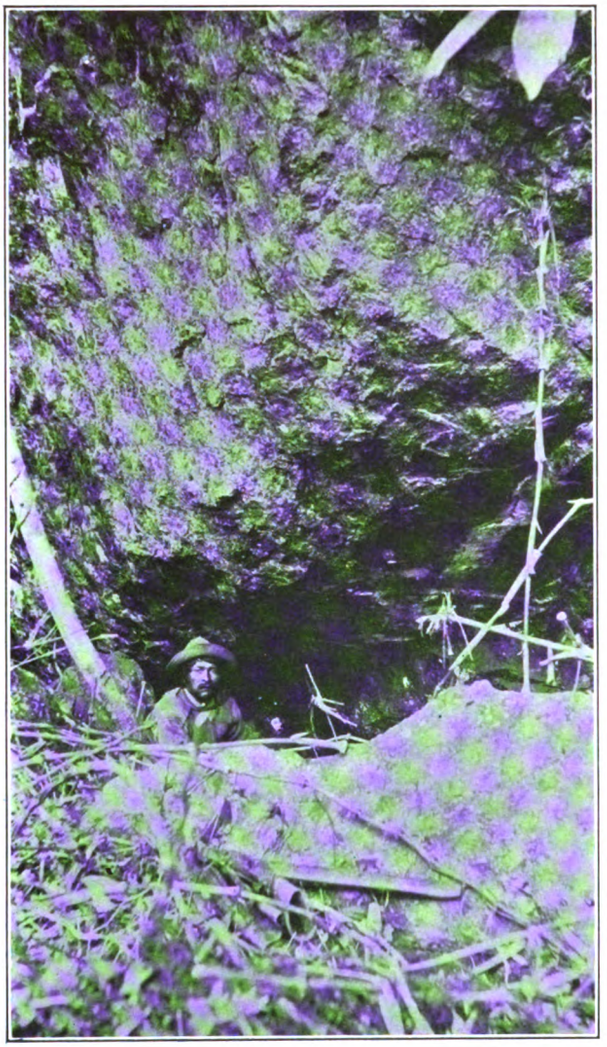

FIGURE 48.—View of Cave 52 with Alvarez. Photograph by the author.

and mattock through the loop of the jug handle, and drew the piece forth uninjured. The rascal then insisted on going through the whole performance again, just to show me how skilful and careful he was. He may thank the great and small Gods of the Mountains that his *encore* was successful!

Fragmentary female skull with jaw and poorly preserved long bones. The skull shows considerable posthumous deformation, due to pressure of rocks covering the grave.

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Fragment (posterior part only) of a large and heavy male skull, with fragmentary skeleton. The very decayed condition of these remains suggests a burial considerably older than the burial designated as Ost. Coll. 3211. The skull belonged undoubtedly to a large male of the coastal type, and the long bones were of corresponding proportions. Close to this skull and presumably placed with it was a bronze tool (Plate II, figure 12) that might have served as a prize-bar or possibly as a stone-worker's "point," the worn condition of the pointed end of the tool and the battered state of the striking end suggesting such a use.

Llama bones were found in profusion beneath the floor of the cave, around and above the interments, the skeletal material of these useful beasts being almost as plentiful as the human remains. Nearly every skeletal part of the animal was represented, and it should be noted that, with the exception of the podials and the patellæ, not an entire llama bone was to be seen. All the long bones were broken, as if to extract the marrow, and a few

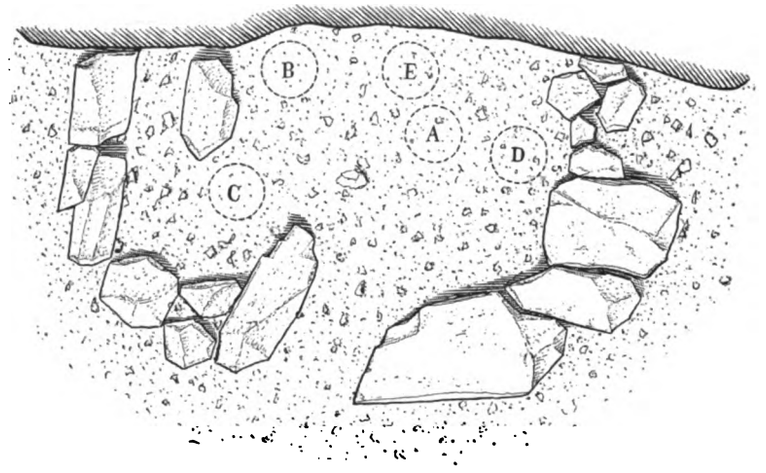

FIGURE 49.—Floor plan of Cave 52.

of the fragments were more or less calcined. Most of the material, however, showed no evidence of having been in the fire. The only lower animal beside the llama represented in this cave was a paca, presumably the new species of *Agouti* described on page 89, and of this animal only a maxilla was seen. Some charcoal was also found, mostly in firm pieces not less than half the size of a hen's egg, in this respect differing from the finely broken and evenly distributed charcoal characteristic of many kitchen middens. I mention this fact because the question may naturally arise whether the extremely fragmentary condition of the llama bones does not indicate that the human interments were made through and beneath the miscellaneous accumulations on the floor of an ancient rock shelter. Some of the grottoes of the Machu Picchu mountainside are undoubtedly natural caves, more or less improved and enlarged by the Indians. In other parts of the American Continent, the bones of food-animals are often to be found in the floors of caves or shelters, the long bones split open for the marrow and usually showing little or no traces of fire. In the present instance, however, although some relics of the early inhabitation of the cave may have become mingled with later ceremonial deposits, it would be very difficult to prove that any of the articles obtained with the human remains are other than conventional garniture of the graves.

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The long bones of the llama may have been split in order that the marrow could be eaten by the friends of the deceased. In some places, it is known to have been the practise of the persons who had charge of mummies to consume the offerings of food made to the dead during the annual festivals.

Mention has already been made of the occurrence in Graves 4 and 9 of pointed weaver's tools made from llama bones. Another implement of the same kind (Ost. Coll. 3382) was obtained from this burial cave (Plate IV, figure 10). Indian customs are slow to change, and this is an ideal weaver's tool. Even near Cuzco, the native women to-day use points or bodkins of the same style and material. When, during my stay at the latter city, I expressed a wish to secure one of recent make for the collection of the Expedition, the Director's orderly, Morales, who was indebted to me for a few cigarettes and some small change, forthwith acquired one by sleight of hand from his mother-in-law. The new piece (Plate IV, figure 12) differs in no important way from the antique bodkins that I collected later, except that it possesses a higher lustre and is redolent of guinea-pig stew and other mysteries appropriate to the Cusquenian ménage, of which *scire nefas*. Evidently tools of this kind have no chronological value.

The complete list of articles found in this cave includes, besides those already mentioned, the following pieces, most of which are shown on Plates II, IV and XIII: M. P. 499, Ingot of bronze. M. P. 767, Pin; probably silver. M. P. 815, Plate. M. P. 827 and 828, Pair of ladles or plates. M. P. 902 and 903, Pair of pelike-shaped jugs. M. P. 943, Chicha jug. M. P. 968, Small broken ladle or plate. M. P. 1887, Hammer-stone. M. P. 1025, Broken ladle or plate.

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THE GRAVES.

Second Series, 53 to 107.

This is the series of burial places at Machu Picchu excavated after my departure. The actual work of collecting was performed principally by the Indians Richarte and Alvarez, who had been with me almost daily during the month that I spent carrying on the search for osteological and archæological material. These men, having acquired considerable skill, both in hunting for graves and in excavating, under the incentive of the small money prizes offered, worked intermittently during the rest of the season, reporting at the close of the field-day, and delivering the booty to the Archæological Engineer of the Expedition. Mr. Erdis carefully labeled and listed the bones and other articles brought in, and recorded such information regarding the location and contents of the graves, as the Indian collectors were able to convey to him. Although he was generally prevented from personally supervising the excavation of these graves, the work progressed admirably under his direction. The amount of valuable skeletal and mortuary material was approximately doubled, and his record of the daily reports of the Indians has been helpful to me while studying the collection. It is perhaps as well, however, not to place implicit confidence in the reports of the Indians, for although their fidelity and activity made a very favorable impression, yet I found them, like many better educated assistants, liable to be somewhat carried away with enthusiasm over attractive "finds" and prone to commit the serious error of mingling specimens from separate locations. Enviable indeed is the career of the collector who can conscientiously cast the first stone in punishment for such offenses. All things considered, the Expedition was fortunate in securing the services of two such reliable Indians as Richarte and Alvarez, and the fact that they were able neither to take notes nor to prepare diagrams of burial places calls for no apology.

Cave 53.

Cave 53 was "about 500 yards southerly from camp, and at a slightly higher level." The following articles were listed: "three human skulls, an animal skull (llama), a pile of sherds, and a finger-ring of silver or copper."

The material also includes some insignificant parts of one, or possibly of two human skeletons, and a few broken limb bones representing two llamas, one animal large, the other small. The bones of chief interest are as follows: Skull and mandible (Ost. Coll. 3214), adult male(?). The determination of the sex of this skull, without reference to other skeletal parts, is not wholly free from doubt, both male and female characters being exhibited in a disconcerting way. The contour of the forehead, the delicacy of the orbital margins and the almost total lack of development of supraorbital ridges and glabella are female characters that are hardly more than offset by the size and weight of the skull and by the slightly masculine form of the zygomata, by the protuberance and curved lines of the occiput, and by the mastoid processes. There is, however, prima facie evidence that a male interment was made in this cave; some of the long bones, e. g., the humeri, exhibit

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proportions that I have not observed in female skeletons of this race, and the skull 3214 is the only skull from Cave 53 that can reasonably be assigned to a male skeleton. No pelvic bones were recovered from this cave. They were probably too poorly preserved to save, which is quite in harmony with the fact that the proximal ends of the femora and the distal ends of the tibiæ have been entirely destroyed through decay. The other two skulls are adult female, and they are not nearly so well preserved as that just described.

Cave 54.

The location of this cave was about 500 yards southeasterly from camp, and its yield comprised: Two human skulls with mandibles; fragmentary vertebræ, ribs, and long bones; some sherds, a small bronze pin, and a small bronze knife with the handle end finished in the design of a llama's head.

Skull and mandible (Ost. Coll. 3216), a large adult male; with the brow ridges and glabella strongly developed, while the zygomata and the occipital squama, on which the external protuberance and curved lines are barely visible, have a strikingly female appearance. The skull is imperfect and is badly warped out of shape.

The fragmentary long bones that accompany this skull call for no special comment, except that burial in the contracted position is indicated by the way in which they have decayed.

Skull and mandible (Ost. Coll. 3217), adult male(?). Sexual characters are not sufficiently pronounced to render the determination certain. The skull is too imperfect to admit of measurement of cranial capacity, but this may be estimated at about 1350 ccm. by comparison with another skull similar in type, and having almost exactly the same diameters of the vault.

Cave 55.

This cave was about 500 yards from the camp in a southerly direction and a little above the level of the Rock-sheltered Terrace. Its contents were reported as follows: "Decayed fragments of a skull and jaw, leg-bones and other bones, and pieces of ollas." Nearly all the human bones in this lot appear to belong to the skeleton of a child twelve or thirteen years of age, the male sex being clearly shown by the pelvic bones. Another individual of about the same age or a little older is represented by a fragment of a left ilium. The specimen is so imperfect that I cannot determine its sex. These human bones afford no indication of the burial positions and call for no further comment. They were accompanied by a miscellaneous assortment of broken llama bones, and by two bones (Ost. Coll. 3386), a left metatarsus or cannon-bone and an imperfect left tibia that should be referred to *Pudua*, a genus of diminutive deer, one species of which has been found in Chile and another in Equador, though according to Trouessart's Catalogue of 1904, neither form has been reported from Peru. The length of the metatarsus or cannon-bone is only 96 mm., yet the complete fusion of the distal epiphysis with the shaft shows that the bone is from the skeleton of a full-grown animal. The two recognized species of *Pudua* are of very small size, the height at the withers of *P. pudu,* the species found in the Chilean Andes, being about 12½ inches,* while the corresponding height of the Equadorian *P. mephistopheles* (from the skin of a nearly full-grown female) is stated by Winton† to be about 320 mm. He

* Lydekker, Deer of All Lands, 1898, page 308.

† Proc. Zool. Soc. London, 1896, page 508 and Pl. XIX.

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also gives the length of the hind foot, without hoof, as 136 mm. Judging from the size of the skull, however, Winton supposed this species to be considerably larger than *P. pudu,* an opinion in which Lydekker concurs.* The foregoing is an insecure foundation for identifying the species of a solitary metapodial, and as far as the length (96 mm.) of the diminutive cannon-bone found in Cave 55 is concerned, the specimen might belong to either species of *Pudua.* At the same time I consider it altogether too small to represent any of the South American brockets of the genus *Mazana.* The accompanying tibia is also unsuitable for specific identification.

Cave 56.

This cave was probably very near the one last described, as its location was recorded in the same general terms. The brief memorandum of the material collected includes a human skull, human and llama bones, small rodent bones, potsherds, and two peach stones. The Indian excavators made no statement regarding the depth at which the peach stones were found or their relation to the human remains. This burial cave is of special chronological interest, for among the numerous bones, both whole and fractured, that were found in it was a fragment from the shaft of a bovine tibia. The specimen, though small and accompanied by no other skeletal parts of the animal, admits of positive identification and is fraught with chronological significance, since domestic cattle were unknown in the American continent before the Conquest. The occurrence of this fragmentary beef-bone furnishes almost indisputable evidence that the Machu Picchu mountainside was visited in post-Columbian times for burial purposes, even if it throws no light on the equally important question whether or not the city was inhabited during the same comparatively recent period. I must regard this specimen as part of the regular garniture of the grave; for by no stretch of the imagination can I assume that a wandering Indian or a treasure-seeker would accidentally leave any part of a bovine tibia in or near a burial cave in a region so remote or difficult to reach, even though the peach stones may have been so introduced. At no period can beef have been a common article of food on the Machu Picchu Mountain.

Another remarkable specimen is one of the rodent bones mentioned above. It is a large lower incisor of a vizcacha, *Lagostomus* sp. (Ost. Coll. 3317), a rodent that seems beyond its usual habitat at this altitude in the Peruvian Andes. No other part of the animal's skeleton was recovered, and it is possible that the large and handsome rodent tooth was a trinket or an article of Indian "medicine," brought from afar by its owner or obtained in trade. Mr. Oldfield Thomas of the British Museum (Natural History) has kindly called my attention to his description of a new species, *Lagostomus crassus,* from a skull found "buried in sand" at Santa Ana, Péru (Annals and Magazine of Natural History, Ser. 8, Vol. V, 1910, page 245). This species is larger and stouter than the typical vizcacha of the Argentine pampas, *L. maximus;* and the tooth found at Machu Picchu may represent the same species, as it is a trifle larger than the corresponding tooth of an example of *L. maximus* in the Peabody Museum of Yale University (Ost. Coll. 1400). The opinion of Mr. Thomas regarding the antiquity of his specimen is also interesting in the present connection: "No viscachas of this genus are known to live in Peru, and the animal is probably now extinct, but the skull is in no way fossilized, and indicates that these animals lived in Peru at a very recent date."

* Lydekker, loc. cit., 1898, page 309.

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The human skeletal material taken from this grave is meager in every respect. It comprises a fragmentary adult cranium of doubtful sex, one loose tooth, five cervical vertebræ, including two axes, one dorsal and two lumbar vertebræ, pieces of a humerus and of an ulna of small size, a few phalanges, and a female left pubis. These bones are all badly decayed.

The skull (Ost. Coll. 3218) appears to be naturally of an oblong form, and it exhibits a very slight Aymara deformation. It is therefore to be regarded as pertaining to the mountain type. It has a capacity of about 1350 cm., which is almost too large for a female, yet the development of the mastoid processes, of the glabella and the supraorbital ridges, and of the muscular ridges of the occipital squama is far below the average for the male sex. There is not the slightest doubt in regard to the female characters of the accompanying pelvic fragment, but the presence of the extra axis shows that two skeletons are represented, and it is therefore impossible to refer with certainty, any of the other bones except a few cervical vertebræ to the same individual as the skull.

There is no record of any bronze or stone implements having been found in this cave, with the exception of a rudimentary stone tool. There are two pieces of llama bone that bear the marks of careful work. One of these is the head of a femur (Ost. Coll. 3383) broken or cut from the neck, and having the cleft surface ground until almost flat (Plate IV, figure 5). For what use this hemispherical bit of bone was intended may easily be conjectured, for with a hole drilled through, it would be similar both in shape and material to a spindle whorl (M. P. 79; Plate IV, figure 4) brought to light during the excavations in the city. A section of the head of a humerus of a llama(?), also found in the city, appears to have been used for the same purpose (M. P. 52). The other worked piece is a cannon-bone of the hind-leg (Ost. Coll. 3387), scored transversely on the anterior and posterior faces of the shaft just above its distal bifurcation (Plate IV, figure 8). The scoring may have been done with the sharp chipped edge of a stone tool. There need be very little doubt as to the purpose of the workman in this case. The specimen is presumably one of the familiar llama-bone bodkins in the first stages of manufacture. The work of a few hours would have finished these two pieces had the maker's life been spared. The rite of burial must have been very exacting in its requirements, if it was thought necessary to include even *unfinished* bone tools among the articles buried in the grave. It is a question whether we should attribute such zealous care on the part of the survivors to their own superstitious fears or to their desire to amply provide for the needs of the dead. The occurrence of pieces of unfinished work in the tomb is mentioned by John H. Blake (Notes on a Collection from the Ancient Cemetery at the Bay of Chacota, Peru. Reports of the Peabody Museum, II, 1878, page 288).

Cave 57.

This location was "600 yards south of our camp and above the level of the Rock-sheltered Terrace." Mr. Erdis notes that the Indians brought in several fragments of a human skull, some loose teeth, various other bones, some potsherds, a copper pin, and two copper articles that have since been identified as earrings or ear-pendants. One of these is preserved (M. P. 533). Among the other articles found here are a piece of a stone knife and a hammer-stone.

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The osteological specimens are of very little interest. About all that can be said of them is that, in addition to an assortment of llama bones, there is just enough human material to show that two adult persons, male and female, were buried at one time or another in the cave.

CAVE 58.

From this cave, which was "600 yards south of the camp and above the level of the Rock-sheltered Burial Terrace," parts of a human skeleton were obtained, apparently representing a medium-sized woman twenty-five years of age. The skull is too fragmentary to permit of its being identified with either the coast or the mountain type.

A bronze earring or pendant was found, similar to those obtained in Cave 57, and also a thin earthenware disk 7 cm. in diameter (M. P. 1791).

CAVE 59.

This grave was "half-way down the mountainside, northeast of the city." From it came three badly broken skulls, a lower jaw and various other bones, some potsherds, two long bronze pins of the kind worn by women (M. P. 537 and 2539) and a small, neatly decorated olla (M. P. 964) containing, when delivered to Mr. Erdis, a remarkable hodge-podge of articles, among which he recognized the following: "2 pieces of twisted rawhide, a small rodent skull, 3 small bits of silver or lead ore, a seed, and 4 pieces of charcoal." The olla, when examined by Professor Bingham after the return of the Expedition, was found to contain several other articles, including some teeth and fragments of charred bone that belong to two of the human skulls taken from this grave.

The pieces of rawhide look a good deal like pieces of the twisted rawhide cords used by arrieros and llama drivers to secure their cargoes. These articles, left in an olla on the surface, exposed to the air and sheltered from moisture, might have lasted for centuries after the decay of the softer tissues of human bodies, if the latter were placed in a more exposed or damper part of the cave.

To a zoologist, the small rodent skull (Ost. Coll. 3318) said to have been found in the olla is a very interesting specimen, by far the most valuable relic from the grave, as it represents a new species of the genus *Abrocoma*. More bones of the same species were afterwards obtained from other graves, and a full description of the new material will be found on page 87.

Several excellent pieces of pottery have since been restored from the sherds collected here. These are as follows: A small handsomely decorated plate (M. P. 805), a two-handled dish (M. P. 838), a small two-handled dish (M. P. 842), a ladle or deep plate (M. P. 1022), and a fire-blackened pelike-shaped olla (M. P. 1058).

The human material from this grave is not especially attractive. There are, as noted above, parts of three skulls. One of these was a small female brachycephalic skull, that is to say, of the coast type. The second skull may also be described as small and female, but I cannot put enough of it together to judge of its physical character. The third skull is represented only by a few poor fragments. It was small and of feminine contours, as far as these are indicated, but its sex cannot be stated with any degree of certainty.

The other human skeletal parts included in the lot are few in number. They are small and slight, and add nothing to the history of the interments. Some of the cranial fragments

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that lay on the surface seem to have been charred, when part of the jungle was burned over in the search for graves. A few pieces of llama bones show that flesh of these useful animals was provided for the spiritual sustenance of the persons buried here.

Cave 60.

This burial cave was "about half-way down the mountainside, east of the city." The record shows that the Indian collectors brought in the following articles:

"A badly broken human skull and mandible, some ribs and other bones, some sherds, a pierced bone whirligig, two bronze champes, and a pretty little olla with broken handle."

The skull is female, adult, rather small, and appears to have been of the undeformed coast type. The human bones that accompany it—cervical vertebræ, ribs, and long bones—are few in number and represent two individuals, one young and the other adult. A few bones of a medium-sized dog and of a llama were found, and there are also some rodent bones that can be referred to *Abrocoma* sp.

Cave 61.

This was "half-way down the mountainside east of the city." The list of the contents of the grave shows that, in addition to the greater part of one human skeleton (Ost. Coll. 3219), a number of valuable articles were found.

A pair of beautifully decorated broken ladles or plates (Plate VII, figures 2 and 3), with handles in the form of realistic human heads, "were placed about six inches from the skull, one on each side," and a thin bronze disk* (M. P. 539) was held by a strip of cloth to the side of the skull—"to the ear," the Indians said. Several bone pendants and some pierced teeth were found, also a number of small shell or stone beads that were attached to the base of the skull by dried mud, thus escaping notice until the bones were examined in the laboratory. Several excellent pieces of pottery, though not so attractive as those already mentioned, have been restored from the sherds taken from the cave. The list of artifacts also includes two diminutive bells similar to that figured by Professor Bingham in the National Geographic Magazine, February 1915, page 184.

The human bones, although in a state of poor preservation, represent nearly every part of the skeleton of a woman of the mountain type, about thirty years of age, and, as far as may be conjectured from the symmetry and delicate contours of the cranial and facial bones and other skeletal parts, of decidedly attractive appearance. The superior quality of the pottery and of the articles of personal adornment found in the grave would perhaps indicate that the owner filled a position of some dignity in the community.

Cave 62.

This cave, also, was in what may be termed the lower grave region, its location being recorded as "half-way down the mountainside, northeast of the city." Fragmentary human bones show that two individuals were buried here. Other articles recorded are:

A large bronze pin (M. P. 557) of the style used by women, a scrap of decayed brown cloth (M. P. 562), a small ornamental bronze bell 1 cm. in height (M. P. 561), ten pieces of quartz crystal, a broken geode, some seeds, and two bits of paint. This paint has the

* Presented to the National Museum at Lima.

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characteristic yellow-brown color of limonite, and is supposed to have been part of the "make-up" outfit of the woman whose bones were excavated here. The pigment, however, was perhaps not applied to the face, but to the legs, after the manner of the Galibi women of Guiana. Describing a female mummy from the Bay of Chacota (one of those collected by John J. Blake), Nadaillac states:* "The legs, from the ankle to the knee, were painted red, a fashion probably dear to Peruvian coquetry, for care had been taken to place near the dead, little bladders of resinous gum and red powder for her toilet in the new life that had begun for her."

The skull of one individual (Ost. Coll. 3220) is a large undeformed adult male skull, having a calculated capacity of 1535 ccm. Although it is badly fractured and beyond the possibility of accurate restoration, it may be regarded as an example of the mountain type. While it is the largest skull in the Machu Picchu collection, it is light, and is far from being the rugose skull of a very muscular man. The inferior border of the left zygoma is as smooth and delicate as that of a fifteen year old girl—a condition not commonly observed in a man twenty-five years of age. The condyles and coronoid processes of the mandible are correspondingly weak. The development of the clavicles and the large size of the heads of the humeri are much more in keeping with the sex of the individual. There are no pelvic bones.

Of the second individual buried in this cave, little was preserved except some inferior fragments of an adult female skull, and other skeletal parts in a state of poor preservation, but all of female size and proportions.

Cave 63.

This cave was "half-way down the mountainside, northeast of the city, and near the foot of Huayna Picchu." Besides a male human skeleton,† which is the most complete and the best preserved of all that were obtained at Machu Picchu, the list compiled in the field includes a number of valuable articles. These are as follows: A woman's bronze pin (M. P. 558), two seeds (M. P. 583, 584), a bronze ear-pendant (M. P. 585), a small bronze bell, (M. P. 586), a bronze pendant (M. P. 587), broken bronze tweezers (M. P. 588), four green stone beads (M. P. 589), a small broken jug (M. P. 916), a pelike-shaped jug (M. P. 886), pieces of brown cloth and a broken crochet needle.

The pieces of brown cloth (Plate III, figures 18 and 19) appear to have been woven from brown llama-wool yarn, the materials being lighter and of different weave from the blanket or shawl found in Grave 26. The broken crochet needle seems to have been lost in transportation, as there is no reference to it in the Provisional List of Pottery, Bronzes, etc., found at Machu Picchu. It was not, however, the only implement of the kind obtained in or near Machu Picchu.

Most of the small articles taken from this grave might belong either to a man or a woman. The crochet needle mentioned by Mr. Erdis would perhaps seem more likely to be a woman's implement than a man's. It should be remembered, however, that present knowledge of the life and labors of the ancient inhabitants, both male and female, of the Inca cities in the mountains is restricted largely to their ceremonial or ritual customs, and it is accordingly difficult to speak with certainty of their minor daily occupations. Among the

* Prehistoric America, page 433.

† Dr. Aleš Hrdlicka of the U. S. National Museum has kindly examined the pelvis.

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modern Indians of this region the work of spinning and weaving is carried on, in part at least, by the men. As to the significance of the bronze pin (M. P. 558) relative to the sex of its rightful owner, small room exists for doubt. The pin is 23.4 cm. long and the width of its semicircular or half-moon shaped head is 5.95 cm. It stands as a good example of a type of pin used at the present time by Indian women only, and is regarded by various writers on Peruvian archæology as an article of exclusively female adornment.

The association of such a pin with the bones of a male individual may well be the cause of surprise. It occurred at Machu Picchu in this instance only, and I am inclined to regard it as due to some error or oversight, either on the part of the collectors or else on the part of the Indians who made the interment. Since I did not excavate the grave and have for my guidance merely the statement of the Indian collectors, it would seem futile to discuss at great length the various ways in which an article of female adornment might have become associated with a male skeleton. When considering the Machu Picchu graves and their contents, however, it is well to bear in mind that some confusion would be likely to occur among the small articles belonging to different individuals, when skeletons or mummies were removed from their original places of burial to other graves, and when interments were made in very old burial caves whose original occupants had either crumbled to dust or been removed to make room for the new-comers.

The human skeleton (Ost. Coll. 3221) found in this grave is that of a man of the mountain type, about forty years of age. His height, calculated from the leg-bones, was 1.61 meters, which may be regarded as a moderate stature, the mean height of Quechua and Aymara males given in Chervin's Anthropologie Bolivienne being 1.602 meters. A few of the bones still have shreds of dried softer tissue attached to them, and in this respect resemble closely some of the bones found in Grave 40. The mere fact that vestiges of desiccated muscles and ligaments are to be seen, is not, I think, sufficient ground for supposing that interment was made at a very recent period.

Measurements of the skull (Plate XXIV) and the pelvis (Plate XXX) from this grave appear elsewhere in this report. It may be noted that while these important parts furnish satisfactory evidence of their male sex, they are very far from displaying those evidences of robust development that are commonly regarded as characteristic of hardy primitive warriors. As regards strength of bone and muscle, this individual was remarkably inferior to some male Indians whose fragmentary remains I had previously collected in a burial cave in the hills overlooking San Sebastian, in the Cuzco valley, the comparison being by no means flattering to the physique of the men whose remains were interred at Machu Picchu.

A few bones of small mammals were collected from this grave. They represent *Abrocoma* sp. and one of the very small members of the *Didelphydæ*. Of the latter, the maxillæ and one mandibular ramus are the only parts preserved, and although the characters of the genus *Marmosa* are indicated, the material is hardly sufficient for identification. From their color, these bones evidently were found buried beneath the earth floor of the grave, and must therefore be regarded as provisions for the dead. As for this purpose, the Indians of Machu Picchu would be likely to provide only such articles of food as would be acceptable to the living, it is presumed that the stewed or roasted flesh of the diminutive opossums of the Andes, animals hardly larger than rats, was accorded its place among the food delicacies of the region.

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Caves 64, 65, 66.

Caves 64, 65, and 66 were close together, about one-third the way down the mountain-side, northeast of the city. They were excavated on the same day by the Indians, and there seems to be some confusion in the material credited to the three localities. Because of the fragmentary condition of the bones, I cannot separate the individuals with certainty.

Cave 64 apparently contained the decayed fragments of one adult human skeleton of small size and probably female. There were also a few recognizable pieces of llama bone, and the middle third of the shaft of a small tibia (Ost. Coll. 3389) neatly cut off just above the nutritive foramen (Plate IV, figure 13). This bone is probably from a small ungulate, either a llama or a deer. It may represent a whistle in the making. Mr. Erdis has recorded that some handsome potsherds were found at this grave.

Cave 65 yielded the fragmentary remains of two individuals, one a child about seven years of age (Ost. Coll. 3222), the other an infant of about twelve months. A plant-spine "needle" with a ring of silver wire passed through the eye (M. P. 1640) may have been the only piece of jewelry the older child possessed—a pin to fasten the shawl across the breast. The wire ring would, of course, preclude its use as a needle.

Cave 66. From this grave were taken two human skulls, three jaws, other miscellaneous bones, some potsherds, a small bronze curette or spoon with the head in the form of a humming bird or other long-billed bird (M. P. 571), a piece of quartz crystal, broken bronze tweezers, and a small shred of brown cloth.

The first human skull (Ost. Coll. 3223) is that of a young woman, nearly adult, whose affiliation with the brachycephalic people of the coast is, I think, evidenced by a moderate degree of occipital flattening.

The second skull (Ost. Coll. 3224) is an adult female, also of the coast type, as denoted by the cranial index 85.5. It is the smallest adult skull in the collection, having a capacity of only 922 ccm.

A few fragments of a third skull go with the third mandible. It seems to have been a medium-sized skull with small mastoids and slight zygomata, but I should not wish to hazard a guess regarding its sex.

The long bones from the three caves, Numbers 64, 65 and 66, are all within the female range of size and proportion, but among a number of imperfect pelvic bones there are two iliac fragments with somewhat narrow greater iliac notches. My doubt regarding the sex of the skull 66C is largely based on the male aspect of these two specimens.

Cave 67.

This location was "half-way down the mountainside, northeast of the city." One poorly preserved adult skeleton was found, together with some potsherds and a large bronze pin (M. P. 768) of the kind used by women. The fragmentary condition of the skull precludes accurate measurement, but it is female and appears to be of the undeformed mountain type. It is certainly not of the pronounced coast type, and shows no traces of occipital flattening.

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Cave 68.

This cave was very near to that last mentioned. Besides an adult female skeleton (Ost. Coll. 3225) in fair but not perfect state of preservation, it yielded a woman's bronze pin (M. P. 770) 27.7 cm. in length, and two small problematic earthenware disks (M. P. 594, 595).

The skull is large, having a capacity of approximately 1280 ccm. It has been deformed in the coastal fashion by the pressure of a flat surface on the occipital squama. As this deformation was seldom or never practised in the highlands, it constitutes almost as good evidence of birth in a coastal settlement as would a naturally brachycephalic form. The woman's height, as calculated from the long bones by Manouvrier's method, was approximately 1.49 meters. Fragments of the pelvis leave no doubt regarding the sex.

Cave 69.

This cave was south of the city, at a higher elevation, and on the side of the mountain toward Intihuatana, i. e., the western slope. Skeletons of an adult woman and of a child about a year and a half old were collected, also a fire-blackened beaker-shaped olla, 27 small stone beads and a handsomely decorated saucer.

The woman's skull (Ost. Coll. 3226) is a good example of the undeformed oblong mountain type. Her age did not exceed thirty years. The pelvis was not collected, but the long bones are in a state of excellent preservation. They are below the average female length, and indicate the low stature of about 1.37 meters. While it is reasonable to suppose that the two skeletons are those of mother and child, there is no proof that such is the case.

Cave 70.

From this cave "half-way down the mountainside, northeast of the city," a few very poor fragments of two skeletons were collected. Both were female, as shown by the pelvis, and while one was adult, the other was hardly more than eighteen years of age. The skulls are too fragmentary to afford any indications regarding their physical type.

Cave 71.

The location given is "two-thirds of the way up the Machu Picchu mountain, south of the city." The partially decayed skeleton (Ost. Coll. 3227) of a young male Indian of the mountain type was collected, with a few pieces of broken pottery. The skull (Plate XXV, figures 1, 2 and 3) displays a moderate Aymara-like deformation, and for an adult male is light and noticeably weak in the development of the zygomata and orbital margins. The other skeletal parts, however, are much more stoutly formed, and are fairly rugose, although the man's height, estimated from the length of the femora, was only about 1.57 meters, which is a trifle below the mean arithmetic height of 1.602 meters for Quechua and Aymara males. From the fact that the skull is bleached by exposure to light and air, while the rest of the skeleton is discolored, it is probable that the grave was shallow and the remains not entirely covered. The position is not indicated.

A few pieces of llama bone show that some provision was made for the supposed requirements of the dead.

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CAVE 72.

From this burial cave, which was "two-thirds of the way down the mountainside, east of the city," fragmentary human remains were collected, representing three individuals.

One of these (Ost. Coll. 3228) was a child about ten years of age. As no pelvic bones were collected, nor any significant small articles, the sex of so young a person cannot be determined. The skull (Plate XXV, figures 4, 5 and 6) is a very interesting specimen, as it exhibits in an extreme degree the fronto-occipital deformation practised by Peruvians of the coast, in accordance with tribal customs and probably to some extent also with ideals of beauty similar to those entertained by the North American Flatheads. It is probably the skull of a young girl selected on account of her physical attractions, for service with other Virgins of the Sun, in one of the so-called convents or Acclahuasicuna.

The second individual was a small delicately formed young woman, whose oblong skull attests her descent from mountain stock.

The third individual, though represented by only a few skeletal fragments, was evidently a small adult woman of similar type to the last mentioned.

A few unimportant sherds were collected in this cave.

CAVE 73.

This cave was located about two-thirds of the way down the mountainside, northeast of the city. Human remains, in a very fragmentary and decayed condition, indicate that three adult women were buried here. One of them, nearing middle age, was evidently of the mountain type. The others were much younger, judging from the wear of the teeth. All three skeletons are small and slight, and one of the women seems to have had a stature hardly more than 1.36 meters, this height being calculated by Manouvrier's method, which, I understand, makes no allowance for racial variation in proportions of trunk and limbs.

In addition to some decorated potsherds, the following articles were found in the cave: Three earthenware disks between 4 cm. and 5 cm. in diameter, a pair of bronze tweezers, a small stone pendant and a small square token or counter of green stone.

CAVE 74.

The recorded location is "at the north end of Machu Picchu, toward Huayna Picchu." Besides the imperfect skeletons of an Indian woman (Ost. Coll. 3229) and her dog (Ost. Coll. 2659), a number of articles were found, including:

M. P. 823, 824. A pair of handsomely decorated ladles or plates.
M. P. 873. A small aryballus.
M. P. 1037. Beaker-shaped olla.
M. P. 1039. Broken jug.
M. P. 1057. Deep dish.
M. P. 1790. Piece of clay or paint, light ochre in color.
M. P. 1902. Small stone counter.
M. P. 2076, 2077. Small pottery disks.
M. P. 2078, 2079. Pieces of wood.
Shreds of closely woven cotton cloth, charcoal and seeds.

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The human skull from this cave is of the undeformed brachycephalic type characteristic of the Peruvians of the coast, its cranial index being 82.8 and its capacity 1055 ccm. From the indications of age afforded by the sutures, the woman was young, probably but little more than twenty-five years of age, yet the maxillary arch was practically edentulous at the time of death, and with two exceptions, the alveoli are entirely obliterated. The zygomatic process, also, of the right maxilla presents a pathologic condition, which may possibly have resulted from extensive infection of the alveolar parapet. The lower jaw has gone astray, but according to Mr. Erdis' notes, a portion of it was collected. As he described it as similar to the jaw of an old person, it seems highly probable that loss of the teeth and absorption of the alveolar margin had given the mandible, also, a senile appearance. Similar conditions were observed in the skull found in Cave 43 (Ost. Coll. 3200). Richarte, the Indian who excavated this grave, stated that the skeleton was in a crouching position, with the hands raised to the ears, and that the sticks of wood were at its feet.

The dog's skull and long bones are very like those that were found in Grave 26, and may be referred to the breed described by Doctor Nehring as *Canis Ingæ pecuarius,* the collie-like Inca dog. Food offerings of llama and opossum flesh seem to have been made, the bones of the latter animal being limited to a mandibular ramus and a maxilla. As the crowns of the molar teeth are nearly worn away, I do not feel competent to decide which of the species of small-sized opossums is represented. It was, however, twice the size of the diminutive animal found in Grave 63, and in this respect a more acceptable article of food.

Referring again to the two pieces of wood from this grave, these were about an inch in cross section and 15 inches long, split from a branch or small tree trunk about 3 inches in diameter, as may be seen from the curvature of the natural outer surface of the wood. I have examined these pieces carefully in order to ascertain if there is anything about their appearance showing whether they were cut and split with a bronze or with a steel axe, hoping in this way to throw light on the age of the interment. Small satisfaction is to be had. I can only say that the tool was dull of edge, and that seven or eight laborious blows seem to have been required in order to cut through a thickness of wood that one stroke of a modern hatchet would easily sever.

In regard to the wood-cutting ability and inclination of the pre-Columbian Indians, they cannot in reason be supposed to have enjoyed this kind of work any more than the modern vagabond who is compelled to pay for food and shelter by doing his measured cord of fire-wood with dull axe and saw. The dried dung of the llama was undoubtedly a convenient fuel of the native Peruvians then as it is now; yet when it became necessary to fell and trim small timber, they certainly were able to accomplish a good deal with their bronze tools, for the architecture of their stone houses bespeaks the use of long and stout roof-frames.

The state of preservation of the two pieces of wood, which are still firm and unaffected by decay, might be cited in support of their recent character with better success than the mere fashion of the work, but the question would remain filled with uncertainty. That which is true of animal tissue is also true of vegetable matter. Only those persons who have sojourned in the Central Andes can appreciate to what length of time organic materials under favorable conditions may be there preserved from the ravages of decay.

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CAVE 75.

The recorded location of this cave is "one-half the way up Machu Picchu mountain, on the side towards Intihuatana." Parts of the skeletons of two individuals were collected here.

Leaving out of account those parts that cannot be assigned with certainty to either sex, it may be said that one individual (Ost. Coll. 3230) is represented by a well-preserved skull (Plate XXVI) and some more or less imperfect long bones. The skull is adult and free from voluntary deformation. It is probably male, though I cannot positively determine its sex. With reference to its physical type, it seems to pertain to the mountain population rather than to the people of the coast, for the mesocephalic index of 78.8 is largely due to the somewhat feminine prominence of the parietal centers, without which peculiarity the cranial index would probably have fallen within Broca's sub-dolichocephalic division. The free movement of this Indian's head was seriously hampered by congenital fusion of the atlas with the occipital bone.

The long bones apparently exceed in their dimensions the averages for Peruvian women, and this is one of the reasons for regarding the skull as male. No part of the pelvis of this individual was recovered from the grave.

Very little of the other skull (Ost. Coll. 3231) is preserved, except fragments of the facial portion. These are accompanied by long bones and pelvic fragments that can be referred without hesitation to the male sex. The bones are stout and rugose, and the man's muscular development must have been excellent. His height, which seems to have been below the mean stature of his race, was further reduced by a severe fracture of the right tibia and fibula, that, through the overlapping and fusion of the bones, resulted when healed in the shortening of the limb by at least a centimeter. One small potsherd was the only artifact collected from this grave.

CAVE 76.

This burial cave was only "about 200 yards east of the foot of the main stairway" of the city. The human bones collected here are meager in every respect, and yield very little useful information. It appears from the long bones that at one time or another, two interments had been made in this cave, one of the individuals being obviously female, while the sex of the other is uncertain. A few pieces of llama bone satisfy the conventions in regard to food.

Besides one whole small pot, probably an aryballus (M. P. 957), sherds of several other vessels were collected, also a number of small stone pieces, mostly counters and ornaments, and a silver pin. This last is of small size, its length being only 10 cm. and its breadth 2.8 cm. There seems to be no reason for supposing that small pins of this description were used exclusively by women.

CAVE 77.

The recorded location of this cave is "half-way up the Machu Picchu mountain, and south of the city." The human bones can be separated into three individuals, two women and a man.

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The first skull (Ost. Coll. 3232) obtained from this cave is that of a medium-sized woman about forty years of age. It is undeformed and is a good example of the coast type, the cranial index being 86.5. Other imperfectly preserved skeletal parts corroborate but add nothing further to the observations made upon the skull.

The second individual is represented by a small adult male skull (Ost. Coll. 3233) restored from many pieces and showing Aymara deformation, by pelvic fragments presenting unmistakable male characters, and by long bones that, while short and light in the diameters of their shafts, have very rugose surfaces for muscular attachment. Judging from the length (bicondylar), 378 mm., of a femur, the man must have been of very low stature. It is interesting to note that while the man's age, indicated by the teeth and sutures, was about thirty-five years, the mastoid processes of the skull are much smaller than those of the average woman.

Of the third individual, there are some long bones and some cranial fragments exhibiting Aymara deformation. It is evident that these are the bones of a small adult woman. A few pieces of llama bones are included in the contents of the cave.

The notes on this cave show that the only small articles collected were a few small potsherds and two pottery spindle whorls (Plate IV, figures 2 and 3) which, Professor Bingham informs me, "are like nothing else found at Machu Picchu," being "much more elaborate than those of the mountains." It is quite possible that the owner brought these whorls from the coast.

Cave 78.

This cave was very near the preceding one. According to the record, three skulls, one of them in good condition and the others badly broken, were found here, together with various other bones, some oddly marked sherds and a pair of bronze tweezers.

One individual not more than sixteen years old is represented by a well-preserved skull (Ost. Coll. 3234) accompanied by other parts of the skeleton. The sex is uncertain, but from the characters of those portions of the pelvis that were saved and from the large size of the skull, it appears probable that the child was male. This skeleton is of unusual interest because of the alterations produced in the form of the left tibia through syphilitic osteomyelitis. Photographic views of this tibia and also of the right tibia, which appear to be normal, are shown with the fibulæ in Plate XXXVI, and skiagrams of the tibiæ, in Plate XXXVII. The change in the curvature of the diseased bone is not, as in typical examples of rickets, effected by a uniform bending, associated with the formation of a buttress of new bone along the concavity of the curve. That the curvature of the posterior surface of the shaft has remained practically unchanged, is evident upon comparison with the right tibia. There is really no bending of the shaft, but the general anterior convexity has been increased by the formation of new bone along the median and lateral surfaces of the upper two-thirds of the shaft, the distal third of the bone being essentially normal and similar to the corresponding portion of the right limb. Another striking and significant difference between the right and left tibiæ is that the latter (the diseased one) is 2 cm. longer, this discrepancy in measurements being supposedly due to the excessive formation of bone at the proximal end of the diaphysis, following the inflammation of the intermediary cartilage and the tissues in its immediate neighborhood. The left fibula was not involved,

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and its length remained equal to that of the right one; consequently the left foot must have been everted outward by the tibial overgrowth.

A wide fistula leading from the medullary cavity to a point near the insertion of the semitendinosus, on the medial surface of the bone, indicates a condition of chronic suppuration; while the uniform effect of the osteoplastic periostitis is diversified in one place by a raised scale of bone, resulting from the partial separation of the periosteal membrane.

I am informed that osteitis deformans is the only disease, other than syphilis, that produces changes even remotely similar to those just described. But osteitis deformans is a disease of old age, practically limited to persons actually or prematurely old. I have been able to find no record of its occurrence in subjects as young as the present individual, whose age did not exceed sixteen years.

The sex of the second individual is doubtful, the material being too limited to justify an expression of opinion.

The third skeleton is obviously that of a small adult woman of the coastal type.

From the manner in which the leg bones of the two last mentioned individuals are affected by decay, the bodies appear to have been buried in the contracted position. The bones of the youth, on the contrary, either because they were in a drier part of the cave or because they were placed there more recently than the others, are not so affected as to afford any indication of the burial position.

Cave 79.

The record states that this cave was "about 200 yards east of the foot of the main stairway," and that the material taken consisted of a baby's skeleton, which lay in the bottom of a large broken olla; also a few pieces of large bones, and some bits of charcoal.

There is very little to be said of this skeleton, except that the child was very young, perhaps new-born. Its occurrence inside the broken olla, however, is a matter deserving attention, as it is the only instance of urn-burial observed at Machu Picchu.* The urn (M. P. 895) is shown on Plate XIV, figure 5.

Among the many references to this form of burial, in Joyce's South American Archæology, the following are of special interest in this connection: (page 148) "The custom of urn-burial is very rare in Peru, and seems to have been practised only in the case of twins who died young. The urns were kept in the house." (page 228) "Urn-burial of any sort is rare in the Andean region, and it is interesting to recall that the Puruha of Equador were accustomed to sacrifice the first-born and preserve the body in a vase of stone or metal."

Reiss and Stübel (Necropolis of Ancon) describe "some graves in which the bodies had been buried beneath large earthenware vessels or portions of them;" and more recently Doctor Hrdlička has related (Anthropological Work in Peru in 1913) the discovery in several localities in the Nasca Region, of "burials in large, stout, undecorated, earthenware urns, especially made for that purpose;" while in the valley of the Ica, "The burials, or at least some of them, were made in large cylindrical earthenware jars or urns, about two and a half feet high and nearly the same in diameter."

* Since this was written, I have been informed that during the excavation of an ancient dwelling at Qquente, a ruin situated on the same side of the Urubamba River as Machu Picchu, and a few miles nearer to Ollantaytambo, the Expedition of 1914-15 found a baby's mummy in the base of a large olla, covered by another sherd of the same vessel. This modified urn-burial was enclosed in a niche of the house wall.

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The urn (M. P. 895) found in this grave is just large enough to receive the remains of a small baby, the inside diameter of the vessel's neck being 17.5 cm., while the inside height and maximum diameter were about 42 cm. and 34 cm., respectively. It was roughly fashioned and is a good deal fire-blackened all around, from its mid-height down to the broken basal portion; it may have been originally made and used for purposes having no relation whatever to the burial rite. The Indians were very expert in firing their choicer pieces of pottery without disfiguring them by the action of smoke, and as a general rule only the cooking ollas are blackened.

The pieces of the large bones mentioned above are from the llama, with one exception—the proximal epiphysis of a human tibia, which has possibly been associated by accident with the other contents of the grave.

Cave 80.

From this cave, which like the last mentioned was "about 200 yards east of the foot of the main stairway" approaching the city, the greater part of a well-preserved human skeleton, including the skull and mandible, is recorded as having been collected, together with a broken plate (M. P. 822) and some sherds. From the sherds two pieces of pottery were probably restored, namely, a flat dish of unique form (M. P. 1071) and a fire-blackened beaker-shaped olla (M. P. 1073). A little confusion has arisen regarding some of the artifacts from this cave and some from the next (Cave 81), and accordingly the source of those articles only that are actually mentioned by Mr. Erdis as having come from one cave or the other can be entirely relied upon. On examining the human material it appears that some poorly preserved parts of another skeleton (female and of small size) were taken from the cave.

That the first individual (Ost. Coll. 3235) was a woman of the coastal type, is made clear by the female pelvis and by the pronounced brachycephalic form of the natural skull. Although apparently not over thirty-five years of age, decay and alveolar abscesses have caused serious losses in the superior dental arcade, and have left only the incisors and cuspids in the lower jaw, the alveoli of the cheek teeth being no longer visible.

Were it not for the unmistakable female characters of the pelvis, there might be some doubt regarding the sex of this individual, for not only is the skull large, having a measured capacity of 1310 ccm. but the long bones are also considerably longer and stouter than those of average size among Peruvian women. Only two female skeletons from Machu Picchu (Ost. Coll. 3157 and 3175) have indicated statures equal to that of this individual.

Cave 81.

This cave was "one-third the way down the mountainside, east of the city." Fragmentary remains found here can be referred with certainty to a man about twenty-five years of age, whose skull (Ost. Coll. 3236) exhibits a moderate Aymara deformation and whose muscular development was excellent, as indicated by the stoutness and rugosity of the long bones. The man's physique was probably equal to, or a little better than that of the second individual (Ost. Coll. 3231) described from Cave 75; yet this strong man from Cave 81, although a trifle taller than the other, was hardly above the mean height for male Peruvians.

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Among the artifacts that undoubtedly came from this grave are the following: A ladle or plate with a bird's head handle (M. P. 803), a hammer-stone 7.1 cm. x 5 cm. x 3.7 cm. (M. P. 1865), a small polishing stone (M. P. 2064), a stone knife or scraper (M. P. 2065), a large hammer-stone 18 cm. x 14 cm. x 14 cm., and a large hammer-stone 27.5 cm. x 15 cm. x 10 cm.

The last two pieces were not saved because of their weight, but Mr. Erdis describes them as being bowlders with rounded sides, and having their two ends badly battered. One can estimate only very roughly the weight of the larger of these two stone hammers, which can hardly have been less than fifteen pounds—an implement that none but a strong man would wish to use. There is every reason to suppose that the Indian whose grave contained this outfit was a stone mason.

A few pieces of broken bone remain from the portions of llama flesh placed in the cave.

Cave 82.

This cave was "half-way down the mountainside, east of the city." Remains of one individual were found there, with a small fire-blackened olla (M. P. 851), a spindle whorl (M. P. 622), a small stone knife or scraper (M. P. 1883) and a small problematic stone object (M. P. 1884).

The skeleton is that of a rather diminutive woman not more than thirty years of age, whose metopic skull (Ost. Coll. 3237) exhibits a slight Aymara deformation. Since this cranial fashion seems rarely or never to have been affected by the Peruvians of the coast, this woman may be regarded as a native of the highlands.

Cave 83.

This cave was very near the city, in fact only "200 feet northwest of the main gateway," on one of the western andenes. Mr. Erdis was therefore able personally to supervise its excavation.

The human material comprises two fragmentary and decayed skeletons, one of them male, judging from the size of the long bones, the other female, as shown by the sexual characters of the pelvis. The few cranial fragments that were saved are practically worthless.

Some llama bones were found in the cave; also a dog's skull and lower jaw, badly decayed, and a femur and tibia of a paca, *Agouti* sp. (Ost. Coll. 3325).

The following articles were also collected:

M. P. 945. A very small jug, height 4 cm., diameter 5.4 cm.
M. P. 1922, 1944, 2058. Pieces of paint.
M. P. 1915, 1917. Knives or scrapers.
M. P. 1916. Stone polisher.
M. P. 1918. Pestle, length 5.7 cm., width 3.6 cm.
M. P. 1919, 1921. Small river pebbles.
M. P. 1920. Small rough stone object.

Cave 84.

From this cave, "200 feet west of the main gateway" to the city, the remains of two individuals were collected, each accompanied by a number of small personal articles that are carefully referred by Mr. Erdis to the individual owners.

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The first skeleton (Ost. Coll. 3238) is that of a young man about twenty years of age. Although, if other skeletal parts were lacking, the skull might almost be mistaken for that of a woman, its male sex is made certain by the pelvis. No ponderous stone implements were found in this delicate featured young man's grave; instead some shreds of rotten brown cloth, and an elaborately incised and drilled gray talc necklace ornament (M. P. 624), shown on Plate IV, figure 7, to which I shall refer again; a number of bone beads and some pieces of what appears to be a bead made of fused green glass. This last article should be carefully considered with reference to the possibility of showing whether the interment is of pre- or post-Columbian age.

The second individual (Ost. Coll. 3239) buried in this cave is proved by his skeleton to have been a small man approaching middle age. The skull (Plate XXVII) is very small, considering its sex, the measured cranial capacity being only 1218 ccm., but its contours exhibit characteristic male irregularity and roughness, and the glabella, zygomata, mastoids and occipital protuberances are strongly developed. The pelvis, which is in an excellent state of preservation, is also thoroughly male in its form. Although the long bones are all fairly well preserved and free from decay, the difference in the discoloration of their proximal and distal ends is so marked as to indicate very plainly that this mummy was interred in the contracted position. The cave seems to have been well sheltered from the weather, since the muscles of the posterior aspect of the left thigh still adhere to the bone as a mass of desiccated and frayed fibers.

Pieces of cloth and cord (M. P. 623, 630, 631) made from brown llama wool had been used in preparing this mummy for the grave; a small black jug (M. P. 944) in almost perfect condition, that doubtless once contained the native equivalent of the restorative conventionally carried in such jugs, two small stone tokens or counters (M. P. 632, 633), two bone heads (uncatalogued), and two bronze neck ornaments (uncatalogued) were also found with the remains. A few fragments of llama bones and a humerus of some large falconiform(?) bird may represent the food provided for the tenants of this burial cave.

Cave 85.

The location of this cave was "half-way down to the river, on the east side of Machu Picchu mountain." The human remains are of comparative little value, for they consist of a few badly decayed fragments from the skull and skeleton of a small adult person—presumably of the female sex. Provisions for the dead are represented by broken llama bones and a few parts of a small opossum's skeleton. The other material found in the grave furnishes a long list, and contains some valuable and interesting articles.

The pin or bodkin (M. P. 635) shown on Plate IV, figure 6, is the prettiest piece of worked or carved bone in the collection. Nearly 9 cm. in length and carefully worked down to just proportions, it has an ornamental head neatly executed in the design of two perched birds in the act of "billing." What genus and species of the *Columbidæ* the clever artist intended to represent, is beyond my knowledge, though if there is anything in a name, there would be a semblance of propriety in referring the birds to *Osculatia* sp. The only point that I wish to emphasize is that the circles inscribed on the perch, like eggs in a nest,* and those representing eyes appear to me, after examination and measurement, to

* The excessive number of eggs is attributed solely to artistic license.

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have been made with the same tool as the circles inscribed on the necklace ornament found in Cave 84 (Plate IV, figure 7). Moreover, the style of the work on the two pieces, when examined critically, exhibits such a striking similarity, that I think both of them are from the hand of the same craftsman. The graves where these pieces were found should be of about the same period.

There are also several small stone counters or tokens (M. P. 636-641); corroded fragments of a small bronze object (M. P. 642); a rough stone implement, polished on one side (M. P. 1896); a pelike-shaped olla (M. P. 887); a long-necked jar of the aryballus type (M. P. 894); a brown, fire-blackened beaker-shaped olla (M. P. 910); an earthenware disk 9.4 cm. in diameter (M. P. 2075), and several pieces of soft, crumbling, bleached fecal matter containing innumerable broken bodies and limbs of ants and small beetles (M. P. 643). It is fortunate that specimens of the material were saved, for no better evidence that some medium-sized or large mammal used this cave could be desired. It is impossible for me to tell positively what the animal was, but the character of the excrement strongly suggests the Spectacled Bear of the Peruvian Andes. The likelihood of animals of this size entering the unprotected burial caves on the Machu Picchu Mountain offers a very plausible explanation of the broken condition in which a considerable part of the skeletal material and pottery was found. I have already alluded (page 49) to the possibility of domestic dogs damaging the contents of open caves, but I have been unable to furnish proof of this; a clumsy bear would be even more likely to create havoc.

Cave 86.

This cave was on the east side of the mountain and one-third of the way down to the river. According to Mr. Erdis, the contents of the cave comprised a few badly rotted bones that "appeared to be mostly llama," a lot of potsherds, and two green stone counters resembling poker chips. This brief summary of the skeletal material is entirely correct. With the exception of a fragment of a human maxilla with a well-worn second molar, the bones all pertain to the llama. This circumstance furnishes two possibilities in regard to the cave: Either the Indian collectors did not excavate deeply or widely enough to find the rest of the human skeleton, or else the remains of the rightful tenant of the grave had almost entirely disappeared through natural process of decay or through removal.

In the Provisional List of Pottery, Bronzes, etc., from Machu Picchu the following articles are referred to this grave: Five small stone counters (M. P. 645-649), parts of a fire-blackened pot (M. P. 907), a pot-lid (M. P. 1055), parts of an aryballus (M. P. 1066), a hammer-stone 13 cm. x 8.3 cm. x 6.1 cm. (M. P. 1913), a hammer-stone 7.4 cm. x 7.1 cm. x — cm. (M. P. 2023), a stone polisher 7.5 cm. x 7.1 cm. x 1.2 cm. (M. P. 1914) and a rough stone object 6.4 cm. x 4.4 cm. x 2.4 cm. (M. P. 2062).

Cave 87.

From this cave, "half-way up the mountain above Machu Picchu," came some fragmentary and decayed bones, including the skull (Ost. Coll. 3240) of a young person about fifteen years of age. The shape of the undeformed immature skull favors the supposition that this individual was of mountain ancestry. A pelvic fragment with a wide greater sciatic notch is a good indication of the female sex. The records show that a piece of silver ore (M. P. 2055) and a few sherds were found with the bones.

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Cave 88.

This cave "half-way up the Machu Picchu mountain, above the city," yielded a child's skull in pieces (Ost. Coll. 3241), a jaw with the teeth not yet erupted, various small bones, and an earthenware spindle whorl (Plate IV, figure 1). Now a baby six or eight months old, which is the approximate age indicated by these infantile remains, could have very little practical use for a large spindle whorl, except possibly to assist in the process of teething. The difficulty in accounting for the occurrence of such an article in this grave is removed by the presence, also, of some decayed and fragmentary remains of an eight year old child, since at this age most of the modern Quechua girls are adept spinners. Judging from the state of decay, the older child's burial considerably antedated that of the baby.

A few pieces of bone indicate that a little flesh from a guinea pig and some from a llama were placed in the grave.

Cave 89.

From this cave, "one-third the way up the mountain, above the city," not a single human bone nor potsherd was obtained. But the Indian collectors won my lasting gratitude by excavating the nearly complete skeleton of a small rodent, referable to the same new species of *Abrocoma* as the skull found in a small olla in Cave 59. The material is described on page 87.

Cave 90.

From this cave, "one-third of the way up the mountain, above the city," the Indian collectors brought in parts of three human skeletons, a pointed weaver's tool (M. P. 656) apparently made from the tibia of a llama, and some sherds. The human material represents three individuals, as follows: A seven-months or eight-months fœtus, a full-term child, and a child of about two years of age. The only piece of pottery that has been restored from the sherds collected here is an aryballus (M. P. 1018). As the minimum diameter of the neck is only 9 cm. this vessel could hardly have served as a funeral urn, even for the youngest inmate of the cave.

Remains of a llama and of a guinea pig, several vertebræ, a scapula and some fragmentary long bones of a very small deer (Ost. Coll. 3391) were also found, the last animal being about the size of the small deer whose bones were discovered in Caves 9 and 55. I have examined this cervine material with the utmost care, to make sure that it could not by any chance be referable to the genus *Ovis,* which would of course indicate that the interments were of post-Columbian age. While it is sometimes extremely difficult to distinguish the fragmentary skeletal parts of sheep and deer, corroborative evidence is to be had, in this case, from the fact that the articular ends of these nearly adult cervine bones are of approximately the same size as those of a new-born lamb.

Cave 91.

This cave was very near the city, its location being "100 yards northeast from the foot of the main stairway."

An imperfect skeleton (Ost. Coll. 3234) of a small woman about forty years of age was found. The skull is a good example of the undeformed coast type, having a cranial index of 87.8.

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Besides a few potsherds, some llama bones and charcoal, the following articles were collected: A bronze pin or needle 7.5 cm. long (M. P. 650), a llucma seed (M. P. 651), three stone counters or tokens (M. P. 652, 653, 655), and a stone disk 5 cm. in diameter (M. P. 654).

Cave 92.

The location of this cave was about "150 yards northeast from the city." Badly decayed fragments of one human skeleton were collected. The skull is too imperfect for accurate measurement, but it is undoubtedly that of a woman of the coast. There is no trace of occipital flattening.

A good many broken llama bones were found, and also some osseous remains of rodents. Among the latter are a humerus and part of a mandible of *Abrocoma* sp., the latter being a valuable addition to the collection, as it is the only mandible retaining the lower incisors that is referable to the new species described on page 87. A species of *Dactylomys* is represented by two pieces, a mandible and a maxillary portion, showing the nearly complete dentition (Ost. Coll. 3322). The teeth satisfy the definition of the dental characters of *Dactylomys,* given by Waterhouse (Natural History of Mammalia, page 310) and compare very closely in size and enamel foldings with Isidore Geoffrey Saint-Hilaire's figures of the dentition of *Dactylomys dactylinus* (Magazine de Zoologie, 1840, Plate 28, figures 1, 2 and 3). As Doctor J. A. Allen's *D. peruanus* from Juliaca, Peru (a species whose dentition has not, I think, been figured), is supposed to be very much smaller in size than *D. dactylinus,* the fragmentary jaws from Machu Picchu are hardly separable from the latter species.

From the sherds collected in this cave the following pieces of pottery have been restored: Two deep two-handled dishes (M. P. 836, 849), a large two-handled plate (M. P. 853), a large round-bottomed vessel (M. P. 891) and a pelike-shaped jug (M. P. 1009).

Cave 93.

From this cave, "about 200 yards northeast from the foot of the main stairway," a skull and various other decayed bones, including pelvic fragments, were collected. This individual (Ost. Coll. 3243) was a small woman not more than thirty years of age, whose undeformed skull is easily assigned to the coast type, in view of the pronounced brachycephalic cranial index of 92.9.

In the Provisional List of Pottery, Bronzes, etc., found at Machu Picchu, no pottery is recorded as having been restored from the few sherds found in this cave, and no bronzes were obtained. But a number of other small articles mentioned in the following list were excavated, which after careful study may eventually throw light on the occupation and the position in the community of the young woman in whose grave they were placed. Two of these articles, Numbers 658 and 661, are shown on Plate III, figures 1 and 2.

M. P. 657. Stone counter, 4 x 3 cm.
M. P. 658. Token, green chlorite schist, 4.6 x 2.1 cm.
M. P. 659. Stone counter, 2 x 1.9 cm.
M. P. 660. Stone counter, 2.2 x 2.2 cm.
M. P. 661. Stone token, green chlorite schist, 5.3 x 2 cm.
M. P. 662. Stone counter, 1.4 x 1.2 cm.

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M. P. 663. Problematic earthenware token, six-sided.
M. P. 1893. Stone knife or scraper.
M. P. 2053. Piece of building granite, 14 cm. x 4 cm. x 2.1 cm. (approximately).

A few fragmentary llama bones show that the usual provision of food for the dead was made.

Cave 94.

This cave was located on the west side of Huayna Picchu. It contained one female skeleton (Ost. Coll. 3244) in a state of poor preservation. A pelvic fragment that was saved exhibits a very wide greater sciatic notch—much wider than any male pelvis in the collection—hence there can be little doubt regarding the sex of the skeleton, although the measured cranial capacity of 1350 ccm. appears rather large for a female. The skull, which is entirely free from deformation, is moderately brachycephalic and should therefore be regarded as an example of the coastal cranial type. Judging from the obliteration of sutures and the state of wear of the teeth, this individual was at least forty-five years old. It is gratifying to find that the sex of these remains can be determined, in view of the difficulty sometimes met with in deciding upon the sexual character of fragmentary human remains, where skulls considerably above average female size are associated with low stature. The occurrence in large osteological collections of a small but disconcerting proportion of adult male crania of effeminate type justifies the pains taken at Machu Picchu to secure all sexually characteristic pelvic fragments, even if so incomplete as not to be available for exhibition purposes.

A good many potsherds were brought from this grave. Most of these have been put together, with the result that the matron's outfit of pottery is shown to have comprised the following excellent pieces:

M. P. 850. Small olla; buff, with design in dark brown on both sides.
M. P. 913. Three-legged brazier in fine brown earthenware (Plate XIV, figure 2).
M. P. 1050. Fire-blackened, beaker-shaped olla, unusual in having two handles, a very small flat handle replacing the customary two-headed snake or other ornament, opposite the main handle (Plate XIV, figure 3).
M. P. 1054. A medium-sized aryballus.

The brazier or fire-pot found in this cave (Plate XIV, figure 2) is an exceedingly interesting piece. Professor Bingham has stated (American Anthropologist, Vol. 17, No. 2, April-June 1915) his opinion that "These braziers were probably used for reheating or annealing small pieces of metal, presumably by means of a charcoal fire." Doctor C. H. Mathewson's comment, quoted in the same article, supports the Director's view. While I do not wish to dispute their opinion, as far as it relates to the possibility of annealing small bronze or silver objects in the vessel, it is advisable to remind my readers that a brazier, even though originally designed for the annealing process, could easily be made to serve some other practical purpose, such as parching maize or carrying live coals to rebuild a fire, that would be more in keeping with the sex of the individual whose remains occurred in this grave. Earthenware vessels without feet but otherwise of the same general form

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are used in the highlands of Peru and Bolivia at the present time for parching maize. As there can be no doubt regarding the female character of the human skeleton obtained with the vessel, the only further suggestion I can make, is that in the nature of things some element of uncertainty, small though it be, must affect any theory based upon the supposed ownership of the brazier by the individual with whose remains it was found.

Cave 95.

This cave was about "250 yards northeast from the foot of the main stairway." The human skeletal material was in a state of very poor preservation. All that can be said of it is that the individual was a medium-sized young woman. The records state that a few sherds were found, together with two small counters of green schist (M. P. 664, 665) and two small odd-shaped tokens of the same material (M. P. 666, 667). Several fragmentary llama bones show that the flesh of that animal was provided.

Cave 96.

It is interesting to note that this cave was on the north side of Huayna Picchu, accessible from the city only by a long and difficult climb. It appears from the records that the Indians collected only a few badly rotted bones and some plain sherds. The interment was that of a small individual, not quite adult. The potsherds include some pieces of a fire-blackened beaker-shaped olla, and among the crumbling bones a few osseous fragments of llama appear. There is also a mandibular ramus and the radius of a small opossum, presumably one of the larger animals of the *Didelphys paraguayensis* group.

Cave 97.

The Indians reported that this cave was "two-thirds of the way down to the river, east of Machu Picchu." A few well-worn teeth and some decayed bones from various parts of the skeleton show that a small adult person was once buried here. Llama bones in profusion indicate that the supposed needs of the dead were amply provided for, and the material brought from this grave includes pottery and various other small articles. The best pieces of pottery are a small aryballus (M. P. 894) and a small wide-necked jug (M. P. 973). Several pieces have not yet been restored. Other articles are listed as follows:

M. P. 668. Token; green chlorite schist, 4.2 x 4.4 cm.
M. P. 669. Token; green chlorite schist, 6.2 x 4 cm.
M. P. 671. Stone counter, 2.7 x 2.6 cm.
M. P. 672. Stone counter, 3.6 x 3.6 cm.
M. P. 673. Bronze ear-pendant (broken).
M. P. 1794. Bit of yellow paint.
M. P. 1795. Rough stone object, 5.3 x 2 x 1.1 cm.
M. P. 1796. Stone knife or scraper, 5.3 x 5.2 x 1.6 cm.

Although this cave was situated a long distance from most of the other burial caves of the Machu Picchu mountainside, there can be little doubt of its belonging to the same period as the burial cave 93, which was about 200 yards northeast from the foot of the main stairway. This will at once appear if the stone tokens, Numbers 658 and 661 from

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Cave 93 (Plate III, figures 1 and 2), are compared with the tokens Numbers 668 and 669 from this cave (Plate III, figures 3 and 4). The question of the true significance of these remarkable stone objects clearly offers a most interesting problem for ethnological investigation.

Cave 98.

This cave was reported to be "one mile southeast from the city, in a saddle of the Machu Picchu mountain." A glance at the map of the mountain makes it seem probable that the location was a little nearer the city—perhaps only about three-quarters of a mile distant—and on the further boundary of what may be termed the upper grave region.

A small man (Ost. Coll. 3245) was buried here, whose skull, if unaccompanied by the pelvis, might easily be mistaken for that of a woman. It is diminutive, and though not in condition for accurate measurement probably had a capacity of but little over 1200 ccm. Those parts of the skull which in the male sex are usually of large size and rugose are here developed only to a very slight degree. As the sacrum, the right innominate bone, and the greater part of the left innominate bone have been preserved, the sex of this individual may be stated positively, notwithstanding the indifferent sexual development of the skull.

No pottery was recorded from this cave, the only articles listed being: A part of a small wooden dish (M. P. 675), a broken wooden spindle whorl* (M. P. 676), a stone counter 3.9 x 3.0 x 0.8 cm. (M. P. 677) and two small bone implements that may have served as awls (M. P. 678, 679).

Cave 99.

The location recorded for this cave is the same as for the last. Pieces of a human skull and jaw, with a few other badly decayed bones, were collected, also some llama bones and the lower jaw of a small rodent. A few potsherds, and seven implements described by Mr. Erdis as polishing stones complete the list.

The diminutive size and female contour of the adult skull are good indications of its sex, additional evidence being furnished by a pair of small slight femora.

The occurrence in the cave of the seven "polishing stones," which were not saved "as they were ordinary and heavy" and which should not, perhaps, be regarded as a woman's tools, presents no difficulty whatever, since there is also a pair of short but very heavy femora that point to the interment at some time of a muscular man of low or moderate stature, in the same cave.

A ladle or plate with loop handle (M. P. 1044) is the only piece of pottery identified among the sherds.

The rodent lower jaw proves to be an excellent specimen of a paca, *Agouti* sp. (Ost. Coll. 3326), with nearly complete dentition. It is a welcome addition to the osteological collection, as it presumably belongs to the new species described on page 89.

* Quoted from the Provisional List of Pottery, Bronzes, etc., found at Machu Picchu. I have not examined the specimen.

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Cave 100.

This cave was about "half-way down the mountainside," east of the Indian Richarte's hut, or in other words, southeast from the city. The human bones collected here represent two individuals, a medium-sized adult of unknown sex and a half-grown child. The material is too meager to show anything further, the chief interest lying in the other contents of the grave. These are listed as follows: A stone token, animal design (M. P. 680); a stone pendant (M. P. 681); a stone token, animal design (M. P. 682); a stone counter, 1.5 x 1.5 cm. (M. P. 683); a stone counter, 2 x 2 cm. (M. P. 684); a circular stone counter, diameter 2.35 cm. (M. P. 685); a stone counter, 2.3 x 2.2 cm. (M. P. 686); a stone counter (M. P. 687); a broken stone token (M. P. 688) and a piece of rusty iron (M. P. 689).

The piece of rusty iron may be first considered. Thoroughly oxidized by exposure, it is now little more than a thin rust flake about 3 cm. long and 1 cm. wide. It looks as if it might be a shard of a knife blade, but this is only conjectural. It does, however, show that the cave was visited for some purpose since the dawn of the Iron Age in Peru. Once learned by a race of men, the knowledge of the manufacture of iron is seldom or never forgotten, and it is generally believed that, prior to the Conquest, the Peruvians were totally ignorant of the process of smelting iron ore. One important point must not be overlooked. The interment is not proved to be of post-Columbian age merely because a bit of rusty iron was found in the burial cave. Treasure-hunters, in scratching about on the floor of a cave, searching for precious metal and for valuable pottery, might very easily leave just such a souvenir of their visit. The present instance, accordingly, cannot be regarded as having equal chronological significance with the occurrence of the fragment of beef-bone in Cave 56, which for obvious reasons cannot be attributed to treasure-hunters.

Granting that a reasonable doubt exists in regard to the age of the interments in this cave (No. 100), the remaining articles found at the grave acquire from this element of uncertainty a greater problematic interest than they would otherwise possess. Most of these articles, some of which are shown on Plate III, figures 5-8, are made from the same green chloritic schist as are the counters and tokens found in Caves 93 and 97, and, I may add, those also found in Caves 101 and 103. Not only are many of these pieces of the same genre, but some of the excellent silhouettes of animals found in different graves may even be the work of the same primitive artist.

It is important to note that all the interments with which these small articles were associated must be regarded as belonging to the same period, whatever they may ultimately prove to be; also that, with one exception, these articles were probably found in the graves of women only, the exception being the child of unknown sex in Cave 100. Several of these pieces have already been figured and briefly described in the National Geographic Magazine for February 1915, and further authoritative information regarding their age and the purpose they served is awaited with more than ordinary interest. It is especially important that, if possible, the genera of the animals represented by these figures be identified, since carvings or silhouettes of European animals will afford as reliable evidence of post-Columbian age as would the actual skeletal remains of animals introduced from the Old World. In regard to this matter of generic determination, I think that most zoologists would identify as a porcupine or some other rodent indigenous to South America, the animal form shown in Plate III, figure 7, of the present report.

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Cave 101.

This cave must have been very near Cave 100, for the Indians reported its location in the same terms. As the contents of the two caves are also remarkably similar in character, I have looked carefully for proof that the two recorded localities were really one and the same. None have been observed in the skeletal material and pottery credited to these two localities, and it may be assumed that no mistake was made.

Very little human material was collected, and even that is in the last stages of decay. One individual only—an adult—is represented; whether male or female, it is impossible to state positively, but the latter sex is indicated. Among the smaller fragments of bone, a right os innominatum of a Peruvian Hare, *Lagidium* sp., occurs.

An attractive piece of pottery, undecorated, but of an old design known from the coastal region and from the highlands as well, is a flask (M. P. 860) with nearly spherical body, surmounted by a tubular handle of semicircular form, from the summit of which the true neck of the vessel arises (Plate XIV, figure 1).

Other articles from this cave are: A small pin, probably bronze, 8,8 cm. in length (M. P. 690); a stone token, unrecognized design (M. P. 691); a stone token, animal design (M. P. 692; a stone token, cross design (M. P. 693) and a broken pelike-shaped olla (M. P. 1074).

The three stone tokens are shown on Plate III, figures 9-11. They should be compared with articles of the same class from certain other burial caves.

Cave 102.

This cave might almost be regarded as within the city, its recorded location being "about 250 feet south of the Temple." As far as I can recall the lay of the land, the cave was probably beneath a bowlder in a small irregular plot of ground near the brow of the western mountain slope and beyond the westernmost houses.

Skeletal remains of one adult individual (Ost. Coll. 3246) were collected, including a rather small undeformed skull of the coastal type in fair state of preservation and exhibiting female characters, together with various other bones not nearly so well preserved as the skull. Not enough of the pelvis was saved to render the sexual determination absolutely certain. Very little pottery seems to have been found, the only recognizable piece among the sherds being a small red flat-bottomed jug. It is neatly fashioned after an old model, but shows no attempt at decoration beyond a few brush marks on the handle.

Cave 103.

The recorded location of this cave is 200 yards east of the foot of the main stairway. The Indian excavators were unable to estimate distances accurately, and it is quite possible that this cave was further down the mountainside than their statement would indicate; in reality it may have been within a few hundred feet of Caves 100 and 101. The skeletal material is extremely decayed and comprises fragments of two female skeletons, one individual being apparently in early adult life, the other middle-aged. Sherds from this cave represent a beaker-shaped olla, two small jugs or flasks and a medium-sized two-handled dish or olla with round or flat bottom. Other articles are as follows: A silver pin, 8.1 cm. in length (M. P. 694); a broken bronze pin (M. P. 698); a stone token, bird design

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(M. P. 695); a stone token, design not recognized, perhaps a sun (M. P. 696), and a stone counter (M. P. 697).

Two of these articles, Numbers 695 and 696, are shown on Plate III, figures 12 and 13. I have already commented on the obvious fact that they fall in the class with the stone tokens found in several other graves.

Cave 104.

This cave was on the northeast bank of the Urubamba River and near the temporary bridge thrown across the stream by Mr. K. C. Heald. At this point, the northeast bank is on the far side of the stream with reference to Machu Picchu.

A few decayed bones of a medium-sized adult person of unknown sex were found, including a small weak mandible but no other parts of the cranium.

The following articles were collected: A small pelike-shaped jug (M. P. 840); a medium-sized two-handled deep dish (M. P. 1020); a three-handled "hydria-shaped" olla (M. P. 1076) and fifteen small river pebbles averaging in size about 2.5 x 1.8 x 1.2 cm. (M. P. 1866-1880).

In view of the style of the pottery, this grave may be considered as belonging to the same period as the majority of the graves that were excavated on the Machu Picchu Mountain. Small river pebbles were occasionally found in graves thousands of feet above the river, and were regarded by my Indians, Richarte and Alvarez, as part of the garniture of the burials, though linguistic limitations prevented a clear understanding of their ideas about the significance of the pebbles. My impression is that the modern Indians looked upon them as ancient fetishes to be placed in the same general class with quartz crystals occasionally found. If river pebbles occurred in graves *only at the river bank,* their presence might be less remarkable, but the fact that they were usually found high on the mountain renders them the subject for ethnological rather than geological consideration.

The following quotation from Joyce's South American Archæology, page 154, may help to explain the significance of these river pebbles, and of the crystals and animal tokens also: "The huaca were innumerable, and, as said above, appear to have been closely connected with ancestor-worship. Each ayllu claimed descent from a common ancestor, and this ancestor might be a rock, lake, river, tree or animal, or some supernatural personage later transformed into a stone, beast or bird."

It is difficult to assign a convincing reason for the location of a grave at the river's edge on the side away from Machu Picchu. There is, however, no evidence of the river having been bridged at this point in ancient times, and accordingly it is possible that, a death having occurred at some place on the far side of the river from Machu Picchu, the desire to inter the body in the historic burial ground of the mountainside was thwarted by the impossibility of crossing the river without making a long detour; hence the remains were buried here, as near as possible to Machu Picchu. Another theory which I should like to submit to the criticism of persons more deeply versed in ancient Peruvian mortuary customs than myself is based on the statement of Herrera, in his Histora General de los Hechos de los Castellanos, Decada V, Libro VI, with reference to the Temple of the Sun at Pachacamac*: "no se permitia enterrar al rededor de èl, sino à Sacerdotes, Señores, i Perigrinos." Possibly

* Four leagues from the city of Los Reyes, the early name of Lima.

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at some period during the occupation of the City of Machu Picchu, only persons of high rank, either by birth or through connection with the service of the Temple and the Acclahuasi, were accorded the privilege of interment on the Machu Picchu Mountain, and the individual whose remains were found in this cave, not being one of the elect, may have been forbidden burial in holy ground.

Cave 105.

This cave was on the west side of Huayna Picchu, its location being recorded in the same words as that of Cave 94. The Indian collectors brought in no skeletal material whatever, the booty consisting of nothing more than a sherd from the base of an olla, a seed, and two pairs of bronze tweezers (M. P. 699, 670). I have searched in vain for any indication that this cave was the same as Cave 94.

Cave 106.

From this cave, "on the east side of Huayna Picchu," the following specimens were collected: "A few sherds of no account, three or four rotten pieces of bones, and a curious rounded piece of bronze with two small horn-like projections at one end." The bronze piece has been figured in the National Geographic Magazine for February 1915, as a "small bronze bell."

Cave 107.

This burial cave, the last one excavated at Machu Picchu, was situated "at the foot of the hill east of the city." By this, I understand that it was near the foot of Mr. Heald's trail and on the Machu Picchu side of the river, not on the far side of the stream as was Cave 104. The foot of the mountain offers many of the same natural facilities for cave-burial as the higher slopes, and the subjects of the Incas or their predecessors were familiar with the locality, having at some distant period constructed andenes along the riverside at this point. In fact the southwestern bank is here protected from the torrent by an immense andean retaining wall, massively constructed of roughly shaped granite blocks.

Remains of three individuals were collected. One of them was a young man of highland ancestry (Ost. Coll. 3247) about twenty-one years of age, and perhaps not quite fully developed. His youth may therefore partly account for the somewhat effeminate appearance of the skull, which although of fair size, as shown by the measured cranial capacity of 1428 ccm. is still notably lacking in the development of those characters usually indicating the male sex. Although the pelvic bones were not recovered, the size and proportions of the humeri and femora, and especially of their proximal articular condyles, are such as to support the sexual identification.

The second individual (Ost. Coll. 3248) was about seventeen years of age, and is represented by various skeletal parts, including a small, light, and essentially female skull (Plate XXVIII) which exhibits an extreme degree of Aymara deformation. A fragment of the pelvis, that fortunately had been saved, affords further evidence of the female sex. The skull of this Indian girl furnishes an excellent example of the type of deformation practised by the ancient inhabitants of the eastern cordillera and of the Bolivian Plateau. It differs fundamentally from the "fronto-occipital flattening" of the coastal region, and seems to have been produced by tightly bandaging the heads of infants across the forehead, over the ears and under the occiput, the bandage being perhaps held in position by a sort of throat-

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latch. Cranial growth within the circumscribed area was greatly retarded, though not entirely checked, with the result that the girth of an adult skull measured along the lines of constriction may not exceed a similar measurement taken from an undeformed five-year old child taken from the same race. Compensatory growth could of course take place only in an upward and backward direction. With such favor was this style of cranial deformation regarded by the Peruvian highlanders, if we may believe the older writers, that the young woman whose enlongated skull was found in this grave was probably considered most attractive by the Machu Picchuans. The profile of her skull should be contrasted with that of the equally bizarre cranium recovered from Cave 72, showing extreme deformation of the coastal type (Plate XXV, figures 4-6). The two skulls represent the most dissimilar ideals of beauty imaginable. It is known that the Spanish conquerors forbade the practise of cranial deformation, but with what immediate success has not yet been learned. It would therefore be quite wrong to assume that every deformed skull dates from before the Conquest. On the other hand, extreme voluntary cranial deformity, either of the coastal or the Aymara type, furnishes satisfactory evidence that the person whose head was thus distorted was reared in a part of the country essentially free and independent from Spanish rule—in other words, in a district where pre-Columbian culture prevailed. By all accounts, the functions of the brain were not seriously impaired by these deformations, which are supposed to have been inflicted through constant though not extremely severe pressure, at a very early age, when bones are yielding and sutures patent. Probably no part of the human skeleton can be artifically deformed with less harmful results than the skull. In the light of modern experience, it even seems possible that distinct social advantages may have been enjoyed by the young women possessing the most rigorously moulded heads. Minor sufferings of childhood are usually forgotten in the heyday of youth, and "il faut toujours souffrir pour être belle." The modern feminine horror of being condemned for life to an absolutely unchangeable fashion probably never entered the minds of these aboriginal, though by no means unsophisticated, American women. As for the men, some of whom appear to have been subjected to like practises during infancy, if their physical powers were likely to be greatly impaired thereby, it is difficult to understand how the custom came into vogue.

The third individual is represented by a few badly decayed fragments of a small adult skeleton. Sex and racial type are alike unrecognizable. This person seems to have been completely interred, as the bones are all equally discolored by earth and affected by decay, while the two other individuals appear to have been placed in the contracted position on the floor of the cave.

Burials within the City.

Burial within the city does not appear to have been the usual practise, at least during the later time of occupation, from which period alone it is probable that human skeletal remains would be preserved. One stone-built bottle-shaped grave was located beneath the surface of the ground, a few rods southeast of the Three-Window Temple, in an area that Professor Bingham has named the Sacred Plaza. This grave may or may never have been occupied. There is nothing to show. When opened by our party, it contained no human remains. If formerly used for burial, the remains had long since been removed, but whether this was done by pious hands or by ruthless treasure-hunters we were unable to learn. Besides calling attention to the fact that the native treasure-hunter rarely burdens himself with bones, I may state here that an empty grave is not necessarily a plundered grave, as was most

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clearly proved to me later in the season, when a closed and apparently finished stone chulpa or tomb at Choqquequirau was carefully opened only to reveal its bottle-shaped interior bare as an empty purse—and as disappointing.

Human remains, however, were found in two places near the Sacred Plaza, and in one place beneath the floor of an outlying building, and a report on the skeletal material collected at Machu Picchu would be incomplete, did it fail to mention these localities.

A fragment of a small human femur was picked up on the surface of the ground outside and below the windows of the Three-Window Temple. Speculation as to how it got there among miscellaneous refuse would be useless.

While clearing away undergrowth and excavating all sorts of debris from an irregular plot of ground a few rods northwest from the top of the Main Stairway, Mr. Erdis discovered a bowlder on which the forms of snakes had been carved. Beneath the bowlder was a small cave (Erdis' Station 9 A) which yielded portions of the upper and lower jaws and of the cranial wall of a small and apparently female, adult human skull. These bones were so badly decayed as to render it quite possible that the rest of the skeleton had entirely disintegrated. From the following partial list of the many articles found in this grave, it appears that a person of some importance was here interred:

M. P. 58. Bronze mirror with pierced square handle.
M. P. 54. Bronze mirror with pierced square handle.
M. P. 53. Bronze knife.
M. P. 55. Bronze knife.
M. P. 59. Bronze pin, length 9 cm.
M. P. 61. Bronze knife (broken).
M. P. 833. Chicha cup.
M. P. 1903. Green stone disk.
M. P. 2002. Green stone disk.
M. P. 1743. Broken chalcedony knife.
M. P. 49, 50, 51, 52, 56, 57. Green stone counters.
M. P. 1144. Piece of red paint.
M. P. 60. Dish handle, crouched human figure.
Small hammer-stones(?).
Polishing stones(?).
Small river pebbles.
Sherds.
Llama bones.

The occurrence of two bronze mirrors and of two bronze knives, not to mention part of a third, suggests the possibility of more than one interment having been made in the cave, but no proof of this can be had from the extremely meager human remains recovered.

While excavating in a building at the south end of the fifth terrace below the semicircular tower, Mr. Erdis came upon a few badly decayed fragments of a human skull and long bones, evidently belonging to a small old individual of unknown sex. The only article recorded as having been found with these bones was a square piece of thin green chloritic schist about 10 x 7.5 cm. in size. This interment may have been already disturbed by treasure-hunters.

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OSTEOMETRY.

On Table I will be found craniometric data of nearly all those skulls whose measurements have been of interest in the present work. In determining the sex of the skulls, I have not only had reference to the usual criteria, but have also consulted the other skeletal parts. In the case of skulls, the characters of which were not sufficiently pronounced to admit of certain sexual determination and which were not associated with other sexually characteristic parts, it has been convenient to make use of the terms *male?* and *female?* Several juvenile and immature skulls, as well as some that are deformed, have been for convenience appended to the series. These specimens should of course be left out of the reckoning, if these tables of measurement are consulted by one interested solely in the study of racial characters. In preparing the tables, I have endeavored to follow the system adopted and recommended by Doctor Aleš Hrdlička of the United States National Museum at Washington, with whose views regarding the desirability of uniform and simple craniometric methods I heartily concur. It will be noted that Doctor Hrdlička's craniometric system differs in some respects from that recommended by the Entente Internationale at Monaco, in 1906.

Nine of the thirty-two measurements of the Entente are omitted, namely:

4° b Hauteur auriculo-bregmatique.
6° Largeur frontale maxima.
7° Diamètre bimastoïdien maximum.
15° Largeur interorbitaire.
23° Courbe transversale.
25° Largeur bicondylienne.
27° Longueur de la branche montante.
28° Largeur de la branche montante.
30° Hauteur du corps mandibulaire.

On the other hand, the Hrdličkan system calls for the cranial module and the thickness of the left parietal, data not recommended by the Entente, and for 21° *a* and 21° *b* substitutes the mean diameter of the foramen magnum, and for 31° the maximum thickness of the mandible at the lower right molar.

In measuring cranial capacity, apparatus made according to the specifications published in Science by Doctor Hrdlička has been used in connection with control skulls of tested capacity. A high degree of accuracy can undoubtedly be attained in this way. Regarding the comparative merits of natural skulls and bronze replicas for purposes of control, I am of the opinion that a natural skull properly treated inside and out with shellac, to render it impervious to moisture, with all the foramina stopped except the foramen magnum, is preferable to the unnaturally heavy bronze replica.

A word of caution should be added in regard to the imported bronze replicas. One of my control pieces, a Number 38 Ranke bronze skull of 1299.7 ccm. capacity, misbehaved from the outset of the work. Examination of the interior of the vault showed that the

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brazing strip, by which the upper and lower sections were united, projected widely into the interior nearly all the way around. A tentorium of this description being abnormal to the *Hominidæ,* the projecting portion of the strip was removed by tools made especially for this purpose. The control skull then gave excellent results, but the labor of cutting adrift the detrimental portion of the brazing strip exceeded that of preparing a natural skull and gauging it with distilled water.

On Table II will be found measurements taken from several of the best-preserved pelves, the system followed being modeled closely after that so successfully used by Sir William Turner in the Challenger Report. As will be seen in the photographic views of three of the pelves (Plates XXIX, XXX and XXXI), Turner's method of mounting the pelvic bones before measuring has been adopted, a thin piece of wash-leather being introduced into each sacro-iliac joint to represent the substance of the sacro-iliac cartilages, while the pubic symphysis is filled in by folds of leather approximating the corresponding cartilage in thickness. In order that the method of computing the indices of the pelvic bones may be perfectly clear, Turner's definitions are here repeated:

Breadth-Height Index is the relation of the maximum breadth and height of the entire pelvis to each other, and is computed by the formula $\frac{\text{height} \times 100}{\text{breadth}}$.

Obturator Index expresses the relative height and width of this foramen, and is obtained by the formula $\frac{\text{transverse diam.} \times 100}{\text{vertical diam.}}$.

Pelvic or Brim Index is the relation of the conjugate diameter to the transverse. It is computed by the formula $\frac{\text{conjugate diam.} \times 100}{\text{transverse diam.}}$.

Iliac Index is the relation of the height-length to the breadth of the ilium obtained by the formula $\frac{\text{breadth} \times 100}{\text{height-length}}$.

Pubo-innominate Index is the relation of the length of the os pubis to the breadth of the innominate bone, and is computed by the formula $\frac{\text{pubic length} \times 100}{\text{innominate breadth}}$.

Innominate Index.—The height-length of the innominate bone being the same as the height of the pelvis, the relation of the breadth of the bone to its height is computed by the formula $\frac{\text{breadth} \times 100}{\text{height-length}}$.

Ischio-innominate Index is the relation of the length of the ischium to the height-length of the innominate bone or pelvic height, and is computed by the formula $\frac{\text{ischial length} \times 100}{\text{pelvic height}}$.

Sacral Index is computed by the formula $\frac{\text{breadth} \times 100}{\text{length}}$.

The photographs of skulls and pelves were taken at a distance of two meters, measured between the lens of the camera and the Basion of the skulls in the one case, and between the lens and the center of the object in the other. At this distance, the camera records very nearly the true form of the skull; in fact the discrepancy between a photograph so taken and a stereographic tracing is almost negligible.

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NEW MAMMALS FROM MACHU PICCHU.

Abrocoma oblativa, sp. nov.

PLATE XXXVIII, FIGURES 1-5.

Skeletal material referable to a new species of *Abrocoma* was obtained from several of the burial caves, whole bodies of the little rodents, or portions of them, having been provided to satisfy the supposed requirements of the dead, in accordance with the custom of the Indians.

Two species of *Abrocoma* were described by Waterhouse in 1837 (Proc. Zool. Soc. London, Part V, 1837, page 30), from specimens collected in the mountains of the Province of Aconagua, Chile, by Darwin during the historic voyage of the Beagle. Until the present time, the genus has not to my knowledge been reported from Peru. Its occurrence at Machu Picchu, about 1200 miles from the locality of the type specimens collected by Darwin, adds greatly to the interest the mere skeletal material would possess, without the pelt, and renders a careful comparison with the Chilean species desirable.

The specific definitions of *Abrocoma bennettii* and *A. cuvieri,* in Waterhouse's Natural History of the Mammalia, include important measurements of the type skulls and are therefore preferable to his original definitions. Several figures of the skull of *A. cuvieri* are given in the Zoology of the Beagle, Part II, and the type skull of *A. bennettii* is figured from the lower or palatal view only, in the Natural History of the Mammalia. Fortunately the osteological collection of the Peabody Museum of Yale University affords for comparison an excellent skull from Chile, the original identification of which as *A. bennettii* was facilitated through the skull being accompanied by the pelt; hence reference could be had both to cranial and external characters.

The measurements of the type skulls were given by Waterhouse in inches and lines. I have taken the liberty to translate these into the metric system, in order to arrange them more conveniently in parallel columns with similar measurements of the three skulls of this genus that are now in the Peabody Museum of Yale University, namely, the skull of *A. bennettii* (Ost. Coll. 1240) and the two skulls (Ost. Coll. 3318 and 3320) from Machu Picchu. Number 3320 is designated as the type of the new species, for which I propose the name *Abrocoma oblativa* in reference to the pious use by the Indians of the flesh of these little animals.

From the accompanying table it is apparent that the skull of the new species differs from those of *A. bennettii* and *A. cuvieri* not only in its much greater size, but also in certain important proportions of the cranial and facial bones. Comparison of the length-width indices shows the Peruvian skull to be much narrower in form than the others, with reference to the bi-zygomatic diameter. At the same time the width of the interorbital space is both actually and relatively greater than in *A. bennettii.* The upper tooth rows in the new form are nearly parallel, while in the other species, especially in *A. bennettii,* the space between the anterior molars is much less than that between the posterior molars. The basioccipital, basisphenoidal and presphenoidal elements are relatively much stouter than in *A. bennettii.*

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With the corresponding parts of *A. cuvieri* they cannot be compared, as the type skull of the latter species, figured in the Zoology of the Beagle, is defective. The "single, tolerably large opening opposite the second molar," thought by Waterhouse to be characteristic of the genus, is here represented by a pair of small foramina placed further forward, opposite to the contact between the first and second molars. The width of the nasal bones anteriorly is greater in the new species, and the nasal portion of the skull is less compressed.

Measurements of Abrocoma Skulls in millimeters.	A. bennettii (type)	A. cuvieri (type)	A. bennettii Y. U. Ost. Coll. 1240.	A. oblativa Y. U. Ost. Coll. 3318.	A. oblativa (type) Y. U. Ost. Coll. 3320.
Length of skull	51.9	35.2	51.0	63.8	65.0
Width of skull	25.4	19.1	25.0	29.2	29.0
Length of nasal bones	19.3	13.2	20.5	23.0	26.5
Width of nasal bones behind	4.8	4.2	5.2	4.8	6.0
Width of nasal bones in front	6.0	4.2	6.0	8.5	9.2
Width of interorbital space	9.0		9.2	13.5	14.0
From incisor teeth to molars	15.8	9.5	15.0	19.0	20.0
Width of incisors	3.2		3.0	3.6	3.5
Length of four upper molars taken together	11.1	7.9	11.0	13.0	13.5
Space between foremost molars	2.1		2.0	4.0	4.0
Space between the last pair of molars	4.8		3.4	4.4	4.5
Antero-posterior diameter of auditory bullæ	15.3		15.0	15.0	15.0
Transverse diameter of the same	11.7		11.0	11.2	11.5
Length of lower jaw	38.5	24.2	38.8		48.2
Length of angular portion of lower jaw	19.4	11.6	20.0		26.0
Height of lower jaw measured from the condyle	16.1	10.	16.0		19.0
Length-Width Index of Skull	.49	.55	.49	.46	.45

Waterhouse states that the "skull of *A. cuvieri* is relatively shorter and the hinder portion is more arched" than is the case with *A. bennettii*. Compared with the figure of *A. cuvieri*, in the Zoology of the Beagle, the new species has relatively flatter parietal bones, and accordingly appears to be much less highly arched posteriorly.

The entire series of upper and lower molars is preserved. While actually larger than the teeth of *A. bennettii*, they are identical in form with those of the Yale specimen of that species, and correspond closely with the figures of the dentition of Waterhouse's two species.

When the fauna of this region shall have been made the subject of systematic study, it will be interesting to learn whether *A. oblativa* must be regarded as an extinct species or as one that has survived to the present day.

No articles of apparent post-Columbian origin were found in any of the graves or caves from which bones of this new species were obtained; accordingly it cannot be claimed here that *A. oblativa* is in every sense a recent animal. In all probability, the cultivated acreage within a radius of twenty-five miles of Machu Picchu is far less now than it was during the empire of the Incas. Moreover, there is to-day practically no hunting and trapping carried on in the region. In fact, general conditions are so favorable to the

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preservation of the smaller herbivorous mammals, that it may still be possible to secure recent specimens both of this new rodent and also of the new species next described.

Agouti thomasi, sp. nov.

PLATE XXXVIII, FIGURES 6-8; PLATE XXXIX, FIGURES 1-3.

Bones of food animals obtained from burial caves and middens include skeletal parts of eight rodents of the genus *Agouti.* Some of the material is very fragmentary, as might be expected considering the manner in which it was preserved; therefore, although it is quite possible that all these animals represent the same species, I cannot prove this to be the fact. It is evident, however, that the largest and best specimen of the series, a fairly well-preserved adult (aged) skull found in a small kitchen-midden near the eastern limit of the city, is distinct from all species hitherto described under the genus *Agouti.* I have therefore selected this skull (Ost Coll. 3327) as the type of a new species, which I have the honor to name *Agouti thomasi* after Mr. Oldfield Thomas of the British Museum (Natural History).

I have for comparison no material of *A. taczanowskii,* M. J. Stolzmann, but the excellent description and illustrations of that author and the comprehensive table of measurements compiled by him show at once that the new type skull does not belong to the species he described from Equador (Proc. Zool. Soc. London, 1885, page 161). The new skull differs from *A. taczanowskii* principally in the following details:

It is longer and has a much smaller zygomatic breadth, while the greatest height of the zygoma is also very much less. The flare or splay of the posterior wings of the zygomata in the new skull is more pronounced than in *A. taczanowskii,* and the maximum zygomatic breadth is conspicuously greater than the zygomatic breadth taken opposite the second molar, while in *A. taczanowskii* the difference between these two diameters is insignificant, the latter species approaching *A. paca* in this respect. I may add that a skull of *A. paca* (Ost. Coll. 120) is actually wider opposite the second molar than at the posterior angles of the zygomata—a peculiarity of form that is correlated with the immense size of the lateral oral capsules.

The surface is quite smooth, even the lower borders of the zygomata being entirely free from the corrugations so characteristic of *A. paca* and *A. taczanowskii.* This total lack of superficial corrugation on the new type skull, which has somewhat thin inferior zygomatic margins, leads me to suppose that it is female, since a younger and slightly smaller skull (Ost. Coll. 3316), Plate XXXVIII, figures 6, 7, from Cave 13, and also a fragment of a still larger skull from Cave 9 exhibit moderately roughened surfaces near the lower borders of the zygomata, the inferior edges of these arches being stouter than in the type skull. I can see no reason why this last difference should not have here the same sexual significance that it has in the case of human crania. As no lower jaw was found with the type skull, an imperfect mandible from Cave 99, presumably of the same species, is shown in Plate XXXVIII, figure 8.

Mr. Oldfield Thomas' *Agouti sierræ* from Venezuela is the species that the new skull resembles most closely, as will appear from the accompanying table, in which are arranged in parallel columns, the measurements of *A. sierræ* (Annals and Magazine of Natural History, 1905, 7th Ser., Vol. XV, page 589) and those of the new Peruvian species.

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Measurements of Skulls in millimeters.	A. sierræ	A. thomasi (type) Y. U. Ost. Coll. 3327.
Greatest length	123	129
Basilar length	99	116
Zygomatic breadth	82	81
Nasals	41 × 22.5	47 × 24
Interorbital breadth	35	32
Tip to tip of postorbital processes	49	42
Least breadth above auditory meatus	37.5	38
Greatest posterior breadth	47.5	48
Occipital height from basion	28.7	29
Length of broadened surface of zygoma	64	68
Greatest height of zygoma	36	37
Zygomatic concavity in horizontal plane	34 × 18	34 × 22
Diastema	38	42
Postpalatal length	38	40
Length of upper tooth (crowns)	28	Approx. 27
Antero-posterior diameter of bullæ	14	15.5

The difference between most of the measurements of the two skulls are slight, but the skull of *A. thomasi* is conspicuously longer in its greatest length and in its basilar length, the latter dimension being presumably less subject to individual variation than the former, which is obviously affected by the development of the occipital crest. The nasal bones of *A. thomasi* are much longer as well as noticeably broader than those of *A. sierræ* and the zygomatic concavities are wider. The bullæ are of good size, having an antero-posterior diameter of 15.5 mm. They are well rounded, not low nor depressed. The length of the skull and the size and prominence of the bullæ should be regarded as important characters, since in the announcement of his *A. sierræ* (loc. cit.) Mr. Thomas throws emphasis on the smaller size of that skull and the very small size of its bullæ. I quote from his summary of the two groups of Paca:

"To the lowland group belong the forms described as *paca*, Linn., *fulvus*, F. Cuv., *subniger*, F. Cuv., and *virgatus*, Bangs, while to the highland series should be referred *Taczanowskii*, Stolzmann, and the present new form [*A. sierræ*], which may be identified by its small size and very small bullæ."

The great distance—over a thousand miles—separating the known habitat of *A. sierræ* from the locality where this new species was found, taken into consideration with the occurrence midway between of a form very different from either, naturally adds courage to my conviction that the Paca inhabiting the Peruvian Andes centuries ago was distinct from the species of *Agouti* hitherto described.

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CONCLUSIONS.

The imperfect state of several of the human skeletons found at Machu Picchu appears to have been due to some cause other than the natural process of decay, and offers an interesting problem in connection with the mortuary customs of the place. The most plausible way of accounting for the loss of certain parts from a skeleton, as a skull, a lower jaw, or bones of a limb, is on the supposition that these portions may have become separated and misplaced or lost, either during the removal of the mummies from temporary mortuaries to their final burial places or else during some festival, when, according to custom, the mummies were taken from houses and graves, and after being washed and perhaps decked in new clothes and wrappings were given places of honor as silent witnesses of various ceremonies.

There is no doubt that veneration of the dead was an important feature of religious belief under Inca rule. Some of the ceremonies in which the mummies were assigned a passive part are briefly described by Christoval de Molina in The Fables and Rites of the Yncas, written between 1570 and 1584. He tells how the annual festival of the Situa was celebrated by the subjects of the Inca at Cuzco in the month of August, and a few passages from the translation by Sir Clements Markham give a clear idea of the attention and care lavished upon the bodies of the dead:

"At the end of their feast (the first day of the festival) they returned to their houses, and by that time a pudding of coarsely ground maize had been prepared called *sancu* and *elba*. This they applied to their faces, to the lintels of their doors, and to the places where they kept their food and clothes. Then they took the *sancu* to the fountains, and threw it in, saying, 'May we be free from sickness and may no malady enter this house.' They also sent this *sancu* to their relatives and friends for the same purpose, and they put it on the bodies of the dead that they might enjoy the benefits of the feast."

The foregoing evidently relates to "all the people, great and small," while the following quotation refers to a part only of the population:

"They also brought out the bodies of the dead lords and ladies which were embalmed, each one being brought out by the person of the same lineage who had charge of it. During the night these bodies were washed in the baths which belonged to them when they were alive. They were then brought back to their houses, and warmed with the same coarse pudding called *sancu;* and the food they had been most fond of when they were alive was placed before them, and afterwards the persons who were in charge of the bodies consumed the food."

The bodies were brought out, richly adorned, and deposited in the square. "All the people of Cuzco came out, according to their tribes and lineages; . . . They passed the day in eating and drinking and enjoying themselves: . . . The priests came out in procession, and the families of Hurin and Hanan Cuzco [Upper and Lower Cuzco] each with the embalmed bodies of their ancestors. They passed that day in the manner already described, and in the evening they took back the Sun and other *huacas* to their temples, and the embalmed bodies to their houses. . . . The same feast called *Situa,* was celebrated at

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the chief places in all the provinces, by the Ynca governors, wherever they might be: and, although the ceremonies were less grand, and the sacrifices fewer, no part of the festival was omitted."

The writings of Garcilasso de la Vega contain very little regarding the feast of Situa, and record nothing at all about the heavy drinking of chicha by the people on that occasion. In his description of the celebration of the *Yntip Raymi,* however, Garcilasso refers apologetically to this failing:* "After the eating was over, they brought liquor in great quantity, for this was one of the most prevalent vices among the Indians. But at the present day, through the mercy of God and the good example which has been set them in this particular by the Spaniards, no Indian can get drunk without being despised and reviled by his fellows. If the Spaniards had set a like example as regards other vices, they would have been apostolic preachers of the gospel."

I have quoted freely from these two most conscientious writers, who were witnesses of many of the acts they described, in order to establish at least a strong probability that the inhabitants of the magnificent city of Machu Picchu, following the practises of their race and times, visited the bodies of their dead at certain seasons and accorded them essentially the same formal honors as have been described in the scenes at Cuzco. Indeed, as Machu Picchu is one of the few "chief places" that seem to have escaped invasion by armed bands of the conquerors, it is altogether credible that some of the ancient mortuary customs persisted there long after their abandonment by those communities that fell completely under the Spanish power.

I now come to a part of my argument that may not seem entirely dignified, yet is advanced for a serious purpose. From the preceding quotations it must be apparent that great quantities of intoxicating liquor were consumed by the Indians at their religious feasts. Although neither Garcilasso nor Molina refer in detail to any disorderly conduct on the part of the people, no one who has witnessed the modern descendants of these same Indians during the celebration of Corpus Christi, more or less intoxicated and struggling for the honor of carrying the effigies of the Virgin and the Savior, can doubt that the closing scenes of the ancient festivals were occasionally conducted with less decorum than was in keeping with their sacred character.

The bodies of the dead were returned to their mortuaries *at the close of the feast.* Is it then to be wondered at that some of the older and more fragile mummies should have suffered from occasional rough handling, especially on the difficult trails of a steep mountain-side where most of the Machu Picchu graves were located, or that lower jaws and parts of limbs or even entire skulls should have been lost, and the mummies not always returned to their former graves?

Other possible explanations of the loss of skeletal parts from the Machu Picchu graves will doubtless suggest themselves to students of South American Archæology. It is interesting to find that Nordenskiöld has recently observed somewhat similar losses from old graves in the Titicaca Plateau. For the sake of brevity I quote from the review† of his Ethnographische und archæologische Forschungen, etc.:

* Royal Commentaries of the Yncas. Translation by Sir Clements Markham. First Part, Sixth Book, Chapter XXII.

† L'Anthropologie, XVII, 1906, page 485.

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"Lorsqu'on souhaite la sécheresse, on retire d'un tombeau un crâne et on le fiche sur une perche. Cette curieuse coutume pourrait expliquer pourquoi Ten Kate a trouvé chez les Calchaquis de l'Argentine tant de tombeaux où le crâne faisait défaut. Si on veut rendre

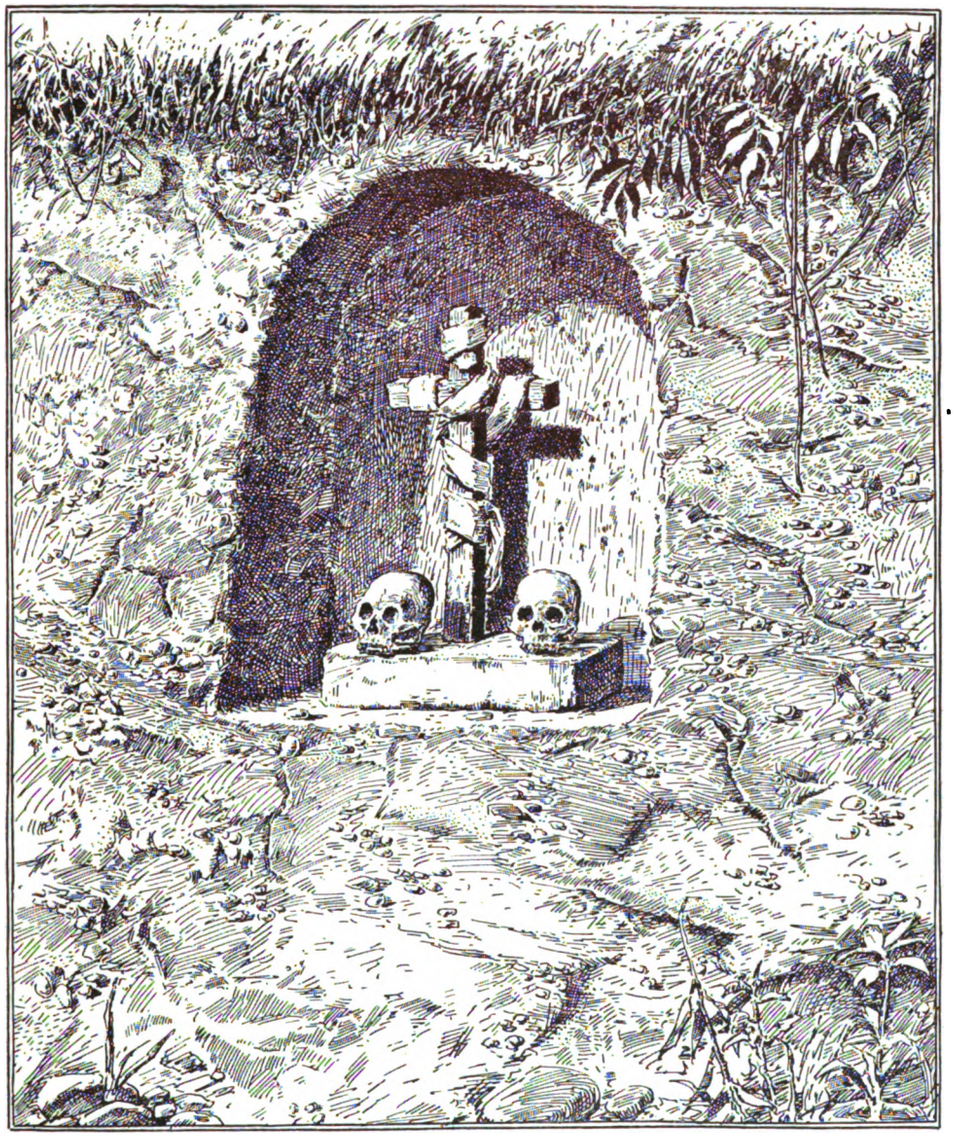

FIGURE 50.—A wayside shrine. Sketch by Mr. T. Diedricksen from material prepared by the author.

quelqu'un malade, on place quelques-uns de ses cheveux ou un object lui appartenant, dans un vieux tombeau."

The last sentence of the foregoing quotation also deserves serious consideration. In any region where attempts were made to cause persons to fall ill by placing objects belonging to them in ancient graves, the human remains and other objects originally placed therein

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would be given a comparatively recent aspect that in some instances might prove extremely deceptive, and even cause a pre-Columbian grave to be wrongly assigned to the post-Columbian period.

While in the Urubamba Valley I saw nothing that would lead one to suppose that the modern Indians of that region remove skulls from ancient graves in order to hasten the close of the rainy season; and yet I did observe a wayside shrine near Huadquiña, about five hours journey from Machu Picchu, where two well-bleached and, to all appearances, old skulls were placed on the pedestal of the crucifix, one at each side, as shown in the accompanying text-figure. I was unable to ascertain what the presence of the skulls actually signified. Inquiries brought little response. Vestiges of ancient ancestor-worship, still to be noted among the modern Indians, are more likely to be concerned in the true explanation than are the teachings of the Church of Rome. I can only state with certainty that a heavy downpour of rain, which made it impossible to photograph the shrine, left serious doubts regarding the magic power of the skulls to produce and maintain a drought.

Taking into account all the human skeletal material found in caves and graves at Machu Picchu, the total number of individuals represented amounts to about one hundred and sixty-four. This assemblage may be conveniently regarded as composed of the following groups:

Adult males	22
Adult females	102
Young males	4
Young females	7
Adults of unknown sex	17
Young persons of unknown sex	7
Infants	5

As the errors resulting from calculations based partly on skulls of determinable type and sex instead of on individual skeletons are trifling, there can be no serious objection to making use of this convenient method of computation.

Of the adult males six appear to be of the coastal type, and fourteen of the highland type. None of the male skulls of the coastal type exhibit voluntary deformation, and only five of the skulls of men of highland ancestry show either typical or variant Aymara deformation. Among the adult females those of highland ancestry while in the majority appear not to have been as numerous as might be expected in view of the city's geographic situation, only twenty-nine skulls of this type having been found as against twenty-eight of the coastal type. The adult female skulls include ten showing Aymara deformation and four showing the fronto-occipital or coastal deformation.

By these figures the fact is at once brought out that the female interments far outnumber those of the males, this discrepancy in the balance of the sexes being so striking as to call for some explanation.

I am strongly inclined to the opinion that during the late pre-Columbian and early post-Columbian periods of occupation, the Inca Empire maintained at Machu Picchu, one of those convent-like establishments known as Acclahuasicuna, and that the female skeletons found in such predominance are largely the remains of Virgins of the Sun and priestesses engaged in the service of the temple. Another hypothesis is that the human remains obtained here represent a population in which the normal proportion of the sexes was modified by the

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withdrawal from the community of most of the active males, to take part in military operations. It will be recalled that with few exceptions the men buried here were individuals of inferior physical development, men who fell far short of the generally accepted definition of the warrior type. This, however, is a condition that would as naturally obtain in a priest-ridden holy city as in a city depleted during war-time of its able-bodied fighting men. On the whole the first hypothesis advanced is probably the more credible of the two.

In order to make sure that no objection could be raised, on historical grounds, to the theory that there was a convent at Machu Picchu, the Director of the Expedition was consulted. He was able, if not to solve the problem, at least to throw additional light on it and to add greatly to its interest, by referring to Father Calancha's Coronica moralizada den Orden de San Augustin en el Peru, written in 1638, which tells of the visit of two Spanish priests to Vilcabamba-the-Old, a city of unknown location, but possibly to be identified with Machu Picchu. Professor Bingham has since then* related this story of the remarkable experiences of the priests while attempting to convert to Christianity the inmates of the ancient city of idolatry. Whether or not Machu Picchu was once known by another name, the significant fact remains that a large majority of the human interments found in its burial caves are female, and that many of these, representing women of both highland and coastal descent, pertain to what may be termed a refined high-bred physical type. This is important, for from what is known of the Virgins of the Sun it appears that only the most attractive young women of the Empire were selected for this highly honorable service, which was in some ways comparable to that of the Goddess Vesta at Rome, but with this difference, that the Inca could choose a consort from the acclahuasi, or could assign one to some distinguished person of royal blood whom he wished especially to honor.

Elsewhere in this report, I have referred to the fact that persons of common origin or of little account were forbidden the privilege of burial in the vicinity of the Temple of the Sun at Pachacamac. It is not, however, necessary to suppose that this rule extended even to skilful artisans employed about the temple. The same may have been true of the burial regulations at Machu Picchu, so that a small proportion of male interments does not render untenable the theory advanced in explanation of the large number of female interments. Viewing human nature broadly and without inquiring too intimately into the duties and manner of life of the Virgins of the Sun, no insurmountable obstacle to the acceptance of this theory is raised by the occasional occurrence of infantile remains. It is probable, too, that other women of high rank, not connected with convent or temple, were buried in the caves of the mountainside.

The problem of the age of the interments is of very great importance. At the same time, it is most difficult to solve fully and satisfactorily. I have already touched upon it while describing the contents of the graves, and there is comparatively little to be added by way of conclusion. It will, I think, be found impossible to show whether the majority of the graves are pre-Columbian or post-Columbian. That most of them present the essential characteristics of pre-Columbian culture is beyond dispute.

Because of our present limited knowledge of Peruvian pathology, it is necessary to guard against hasty conclusions upon the age of certain diseased human bones described and figured in this report. It is only a very few years since any American skeletal material known to

* National Geographic Magazine, February, 1915.

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be syphilitic would have been regarded by the majority of Pathologists as undoubtedly post-Columbian. Through the scholarly researches of Doctor Iwan Bloch it now appears that syphilis is a disease of great antiquity in the New World, and that it was brought to Europe from Haiti by Columbus' crew on their return from the First Voyage. Therefore the fact that bones from either North or South America show syphilitic alterations cannot be accepted as satisfactory evidence that they belong to the post-Columbian period.

In regard to the antiquity of human remains, when there is no geological evidence to be cited and little or no assistance can be had from history and tradition, the conscientious investigator must generally be content (and must ask his readers to be content also) with such indications of age as are afforded by the character of the artifacts and natural objects associated with the human remains.

The difficulty of this method of attacking the problem—and it weighs down with heavy ballast small craft about to venture upon these seas of doubt—is that while on the one hand objects of recent origin, rightfully associated with human remains, must be accepted in proof of recent age, on the other hand the total absence of objects of modern origin, although essential to any claim to antiquity, does not in itself constitute proof of antiquity.

In two of the graves, articles of post-Columbian or European origin were found. These graves, Numbers 56 and 100, must accordingly be regarded as recent, although, to be exact, in only one instance, namely, Cave 56, where the fragment of beef-bone was obtained, is the evidence entirely convincing. The possibility that some interments in the ancient burial region may also have been made during comparatively recent times has been commented upon elsewhere in this report. Without fear of misapprehension, I can therefore repeat, that the majority of the interments were accompanied by no articles of exclusively post-Columbian or European origin, and that the general aspect of most of the graves is distinctly favorable to the supposition that the people whose remains were placed there lived and died under those conditions of autochthony that define the pre-Columbian culture.

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Explanation of Plate I.

All figures are natural size.

Figure 1.—M. P. 774. From Grave 26. Large bronze topo or cloak pin.

Figure 2.—M. P. 776. From Grave 26. Bronze tweezers for the lady's toilet.

Figure 3.—M. P. 773. From Grave 26. Large bronze topo or cloak pin.

Figure 4.—M. P. 772. From Grave 26. Concave bronze mirror. This piece has been subjected to metallurgical tests, and the author has been unable to restore it wholly to its original form.

Figures 5 and 6.—M. P. 778 and 781. From Grave 26. Sewing needles made from plant spines.

Figure 7.—M. P. 780. From Grave 26. Bronze object, possibly the lady's *cure-oreille*. The handle is finished in the design of a bird with outspread wings. A bit of string is preserved in a hole through the bird's body.

Figure 8.—M. P. 779. From Grave 26. Small bronze pin with spheroidal head and a pierced lug for a retaining cord.

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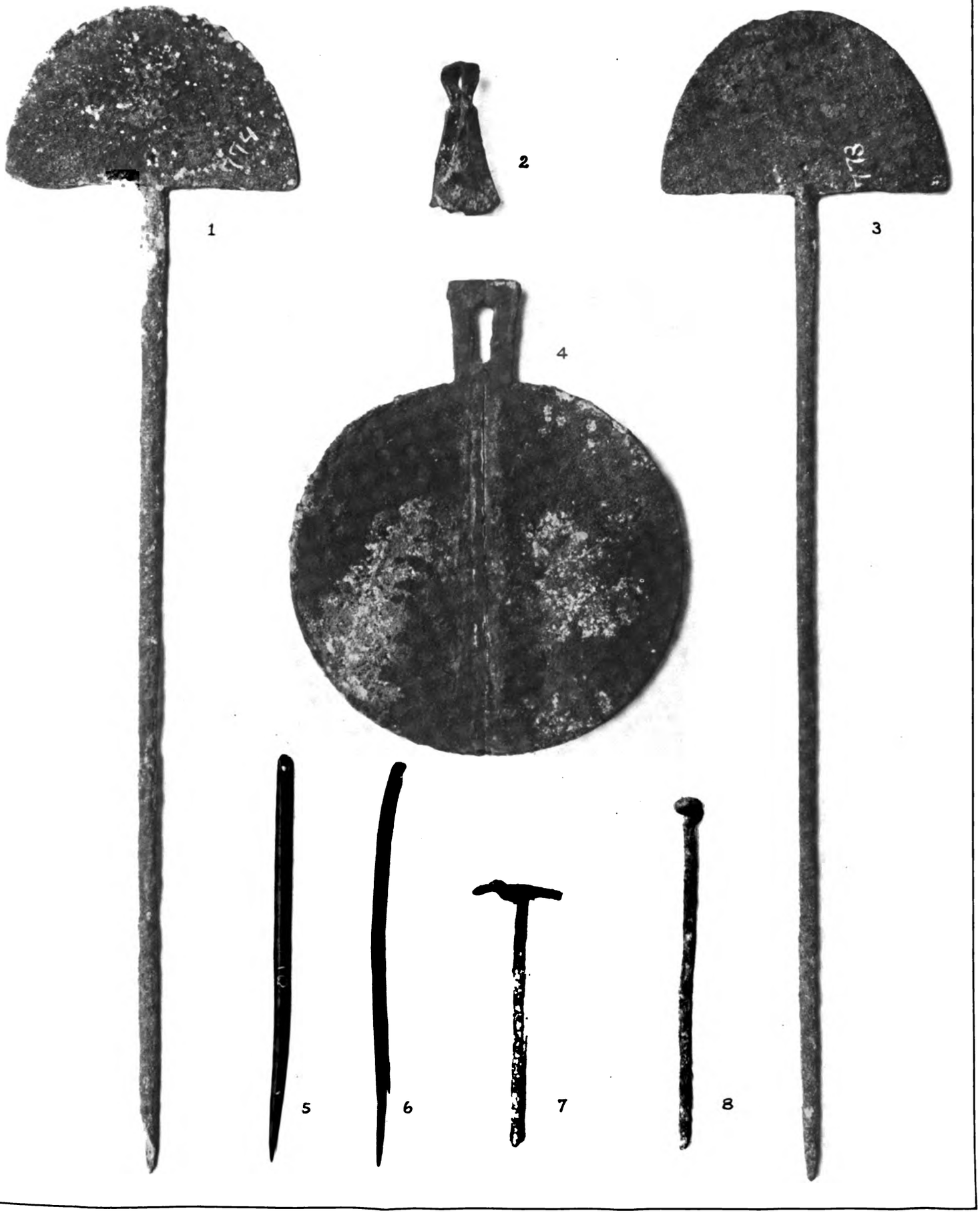

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Explanation of Plate II.

Figure 1.—M. P. 747. From Cave 14. Bronze knife, with pierced flat handle. Slightly marred since excavation. Natural size.

Figure 2.—M. P. 753. From Cave 29. Large topo or shawl pin. Probably silver. Natural size.

Figure 3.—M. P. 754. From Cave 37. Broken ear-pendant(?). Bronze. Natural size.

Figure 4.—M. P. 755. From Cave 37. Broken bronze needle or pin. Natural size.

Figure 5.—M. P. 756. From Cave 37. Small pin. Probably silver. Natural size.

Figure 6.—M. P. 757. From Cave 37. Small bronze tweezers for the toilet. Natural size.

Figure 7.—M. P. 758. From Cave 38. Bronze knife with heavy square-sectioned handle. This piece has been subjected to metallurgical tests, and the author has been unable to restore it wholly to its original form. Natural size.

Figure 8.—M. P. 760. From Cave 38. Topo or shawl pin of bronze. Natural size.

Figures 9 and 10.—M. P. 759 and 761. From Cave 38. Topos or shawl pins. Probably silver. Natural size.

Figure 11.—M. P. 764. From Cave 45. Bronze tweezers for the toilet. Natural size.

Figure 12.—M. P. 766. From Cave 52. Bronze tool of rectangular section. Probably a stone mason's point. The slight scale-like marring of the piece results from its having been secured in a rough-faced vise during metallurgical tests. One-half size.

Figure 13.—M. P. 499. From Cave 52. Bronze ingot. One-half size.

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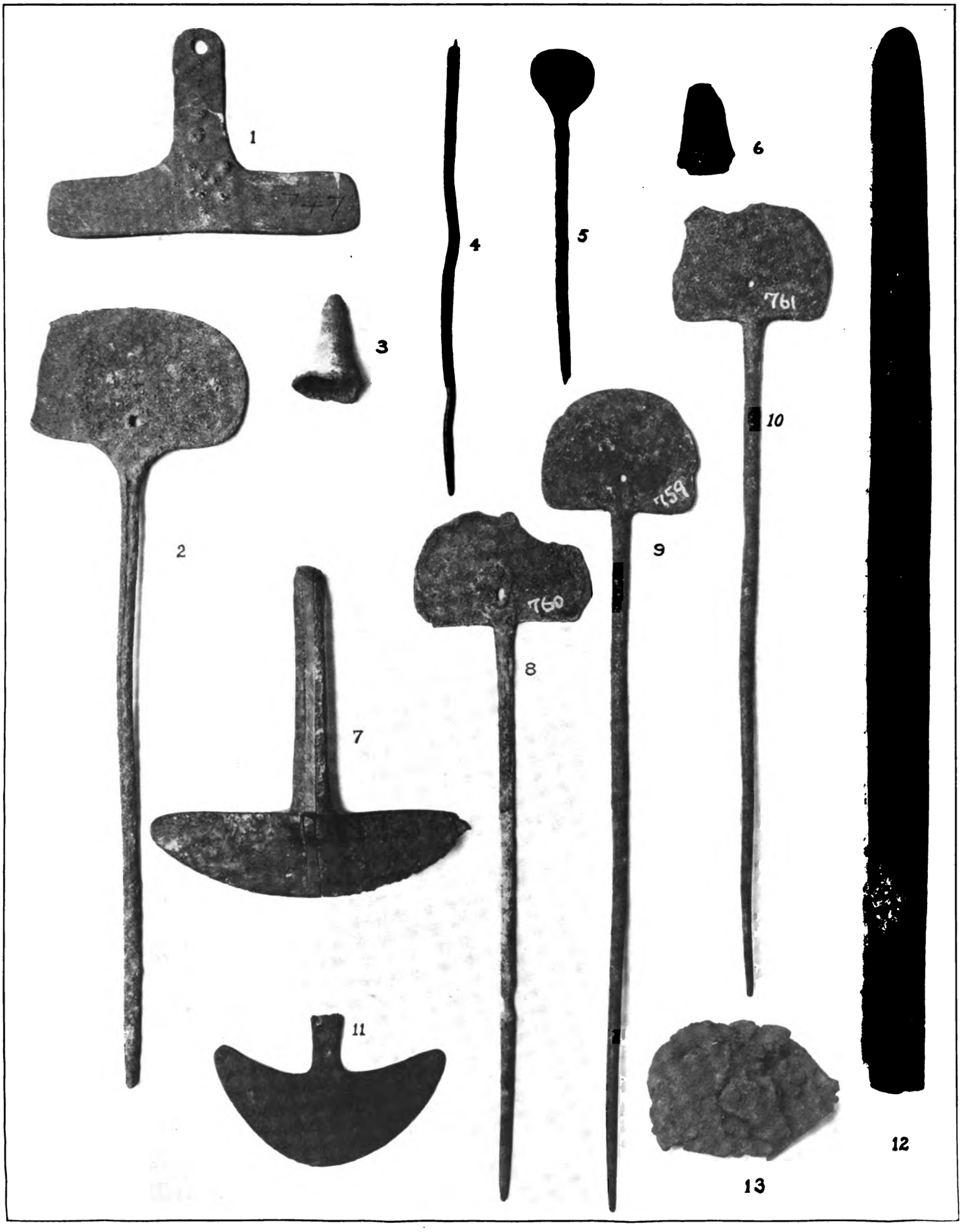

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Explanation of Plate III.

All figures are natural size.

Figures 1 and 2.—M. P. 658 and 661. From Cave 93. Objects of green chloritic schist.

Figures 3 and 4.—M. P. 668 and 669. From Cave 97. Objects of green chloritic schist.

Figure 5.—M. P. 680. From Cave 100. Token of green chloritic schist. Animal design.

Figure 6.—M. P. 681. From Cave 100. Pendant or token of green chloritic schist.

Figure 7.—M. P. 682. From Cave 100. Token of green chloritic schist. Animal design.

Figure 8.—M. P. 685. From Cave 100. Token of green chloritic schist.

Figure 9.—M. P. 691. From Cave 101. Token of green chloritic schist.

Figure 10.—M. P. 692. From Cave 101. Token of green chloritic schist. Animal design.

Figure 11.—M. P. 693. From Cave 101. Token of green chloritic schist.

Figure 12.—M. P. 695. From Cave 103. Token of green chloritic schist. Animal design.

Figure 13.—M. P. 696. From Cave 103. Token of green chloritic schist.

Figure 14.—From Grave 26. Heavy fabric of brown llama's wool.

Figure 15.—From Grave 26. Heavy fabric of brown llama's wool.

Figure 16.—From Grave 26. Coarse material of vegetable fiber.

Figure 17.—From Grave 26. Medium weight fabric of fine light brown wool.

Figure 18.—From Cave 63. Medium weight fabric of brown wool.

Figure 19.—From Cave 63. Heavy fabric of brown llama's wool.

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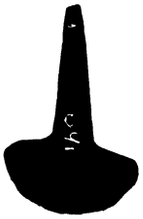

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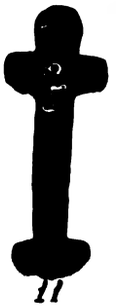

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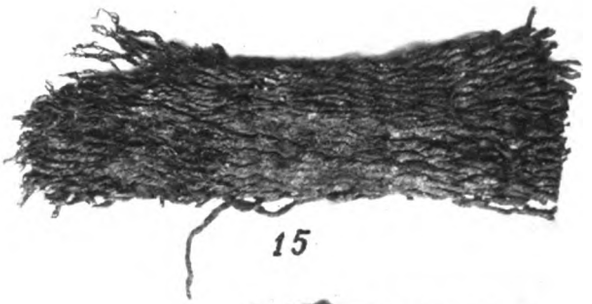

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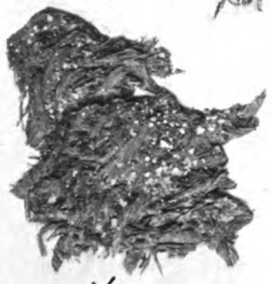

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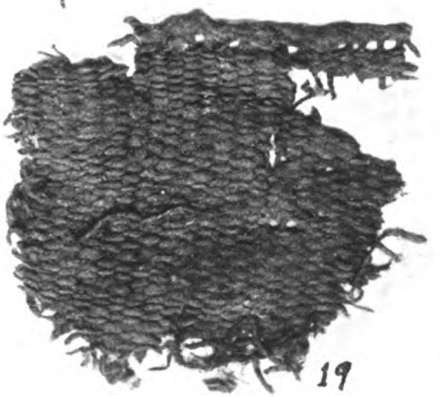

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Explanation of Plate IV.

Figure 1.—From Cave 88. Two views of an earthenware spindle whorl. Natural size.

Figure 2.—M. P. 614. From Cave 77. Earthenware spindle whorl. Natural size.

Figure 3.—M. P. 615. From Cave 77. Earthenware spindle whorl. Natural size.

Figure 4.—M. P. 79. From Station 11A in the city of Machu Picchu. Spindle whorl made from the head of a llama's femur. Natural size.

Figure 5.—Ost. Coll. 3383. From Cave 56. Severed head of a llama's femur, showing first stage in the making of a bone spindle whorl. Natural size.

Figure 6.—M. P. 635. From Cave 85. Ornamented bone pin or bodkin. Natural size.

Figure 7.—M. P. 624. From Cave 84. Three views of an ornament made of gray talc. Found with human skeleton, Ost. Coll. 3238. Natural size.

Figure 8.—Ost. Coll. 3387. From Cave 56. Llama's metatarsus, showing first stage in the making of a bone weaver's point. Three-fourths natural size.

Figure 9.—Ost. Coll. 3383. From Grave 9. Weaver's point made from a llama's tibia. Three-fourths natural size.

Figure 10.—Ost. Coll. 3382. From Cave 52. Weaver's point made from a llama's metacarpus. Three-fourths natural size.

Figure 11.—Ost. Coll. 3390. From Cave 27. Weaver's point made from a llama's metatarsus. Three-fourths natural size.

Figure 12.—Weaver's point made from a llama's bone, and recently in the possession of Soldado Morales' mother-in-law at Cuzco. Three-fourths natural size.

Figure 13.—Ost. Coll. 3389. From Cave 64. Shaft of a small ungulate's tibia from which the proximal portion has been cut or ground away. Natural size.

Figure 14.—Ost. Coll. 3384. From Grave 9. Thin and sharp-edged tool. Natural size.

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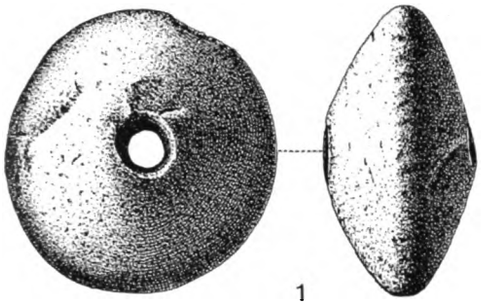

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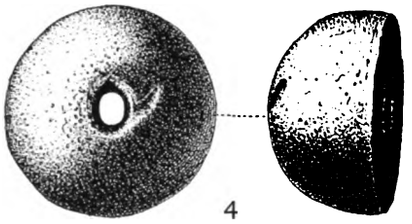

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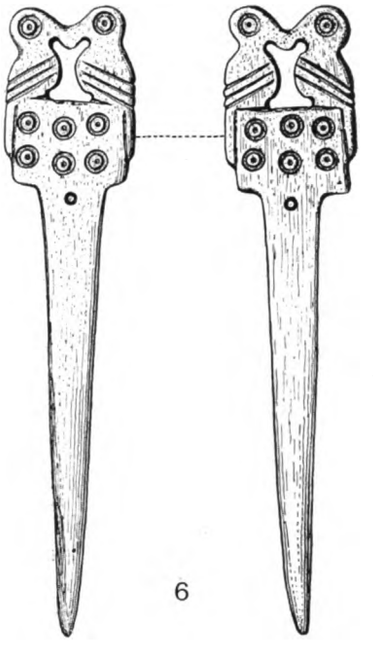

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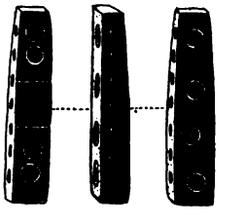

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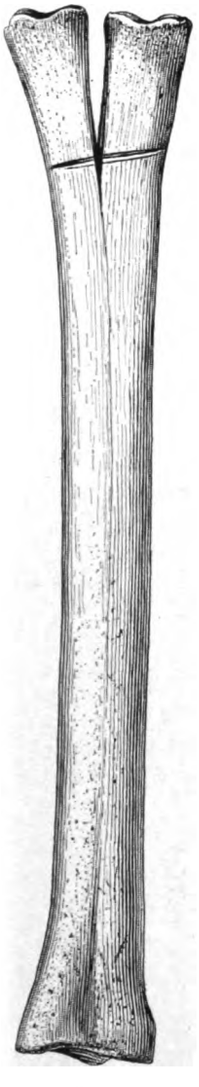

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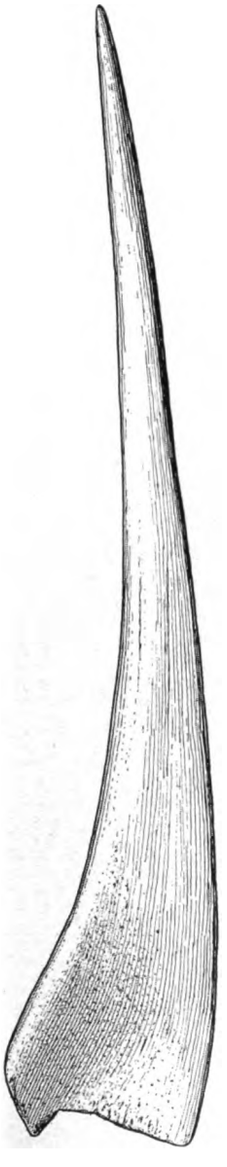

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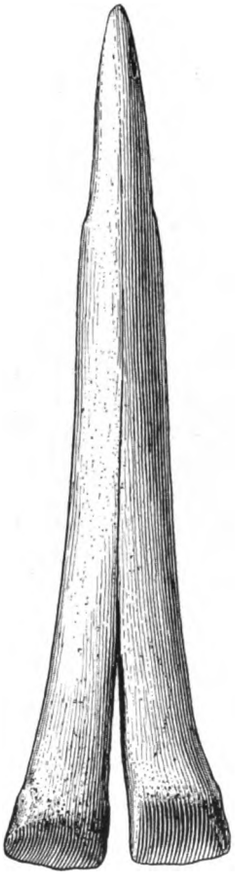

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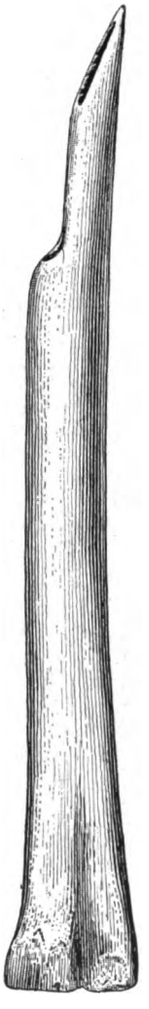

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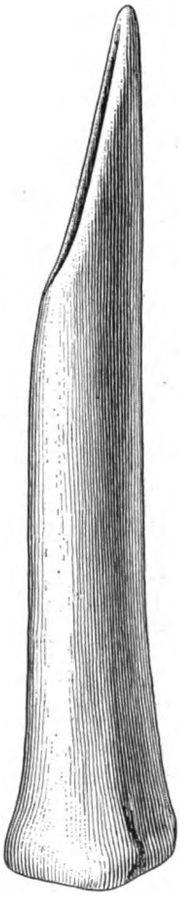

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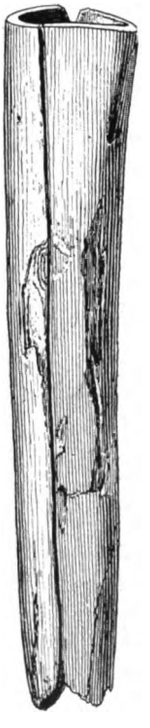

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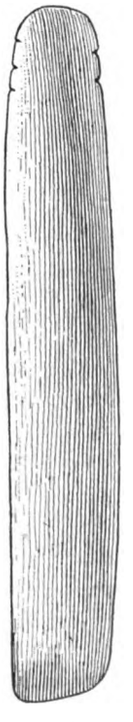

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Explanation of Plate V.

Figure 1.—M. P. 835. From Cave 3. Deep two-handled dish or olla. Red, with design in black and white on body, and in black on handles. Height 11.5 cm.

Figure 2.—M. P. 900. Large aryballus, restored from sherds scattered about the floor of the large rock-shelter where Grave 9 was found. Light brown, with decoration in red and black. Height 64.5 cm.

Figure 3.—M. P. 932. From Cave 14. Two-handled dish. This had been broken, and apparently repaired, or an attempt made to repair it, by fastening the sherds together, small holes having been drilled for the fastenings of cord or wire. Diameter of body excluding handles 19.8 cm.

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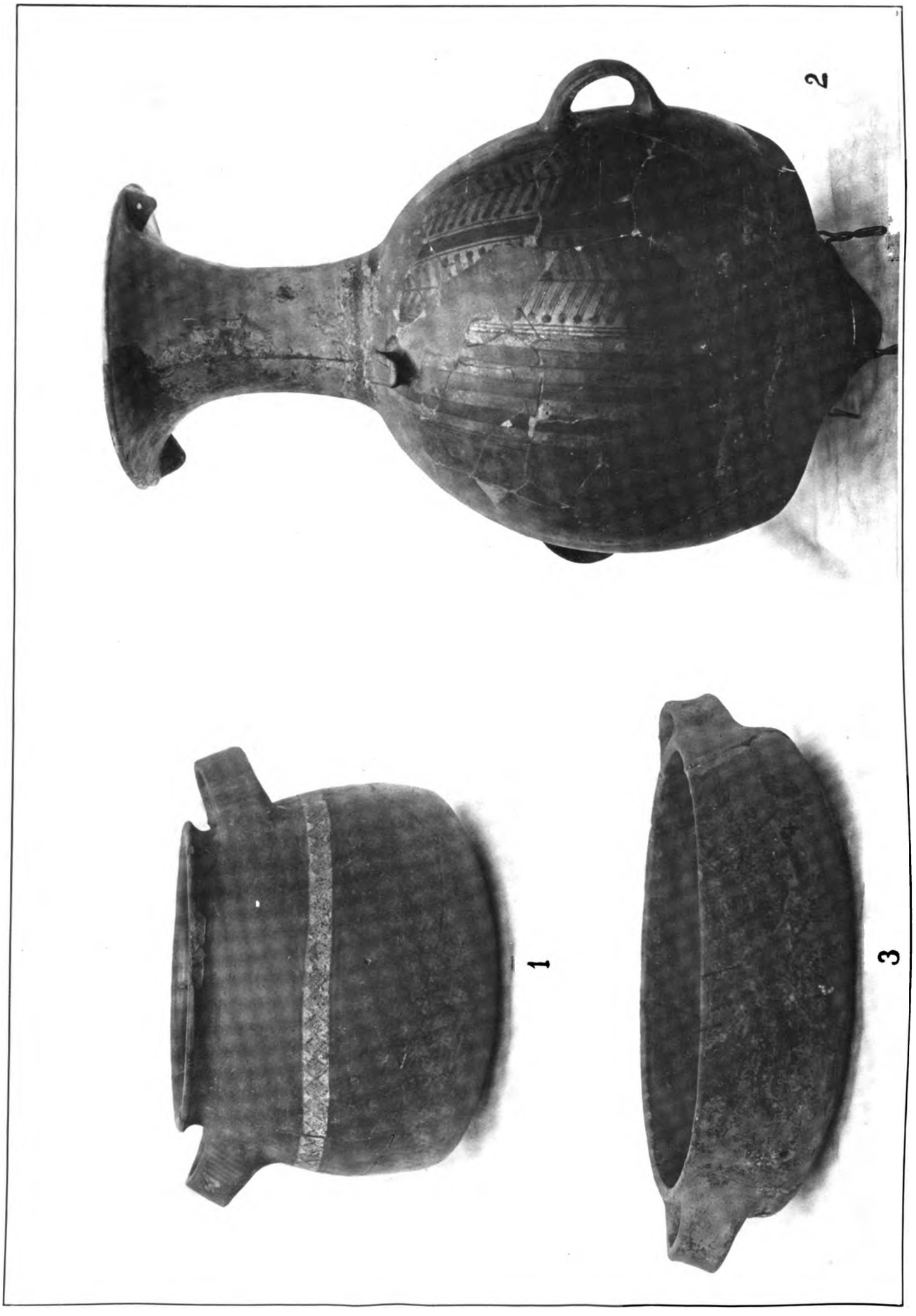

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Explanation of Plate VI.

Figure 1.—M. P. 940. From Grave 26 in the Rock-sheltered Terrace. Beaker-shaped olla. Dark red, fire-blackened at the base. Height excluding handle 10.5 cm.

Figures 2 and 3.—M. P. 938 and 939. From Grave 26. A pair of jugs with human faces modeled and painted on the necks. Light brown, with red and white designs Heights 14.5 cm.

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Explanation of Plate VII.

Figure 1.—M. P. 892. From Cave 28. Aryballus. Red, with white neck, and conventional stripe design in red, black and white on body. Height 38 cm.

Figures 2 and 3.—M. P. 817 and 930. From Cave 61. A pair of ladles or plates, with handles modeled and painted in the designs of human heads with large pierced ears. Light red. Designs in deep red, white and black. Diameters excluding handles 16.3 cm.

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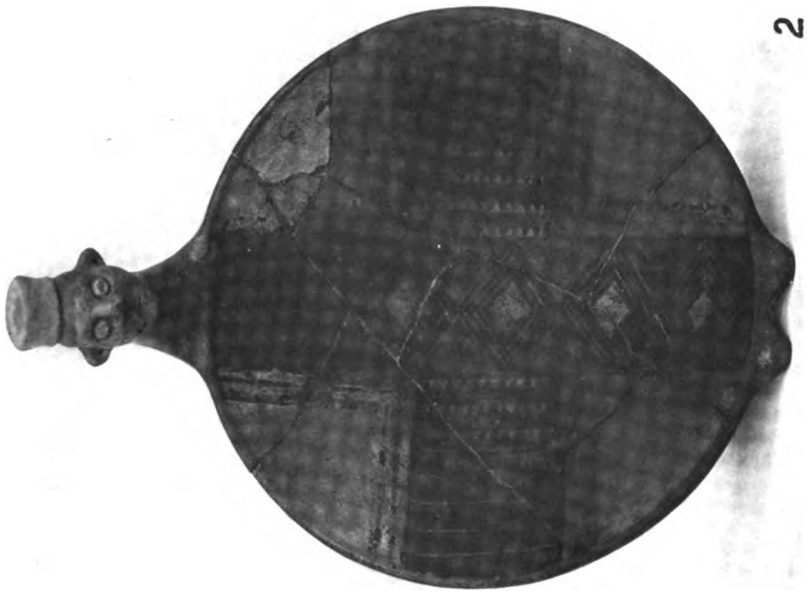

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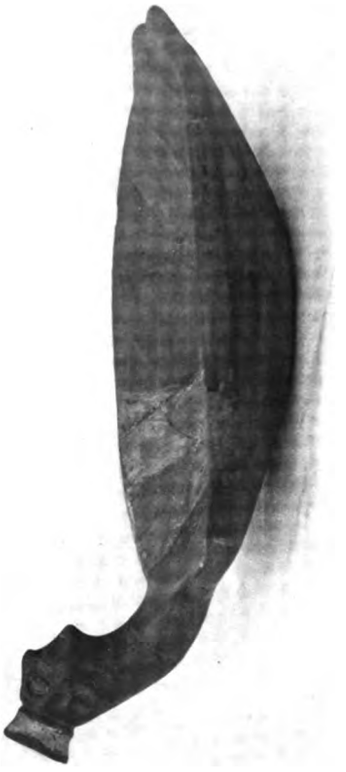

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Explanation of Plate VIII.

Figure 1.—M. P. 935. From Cave 29. Deep two-handled dish. Dark red with designs in red, white and black. Height 8 cm.

Figure 2.—M. P. 1056. From the rubble outside Cave 29. Small concave pot-lid. Red. Diameter 11.2 cm.

Figure 3.—M. P. 841. From the rubble outside Cave 29. Small two-handled dish. Red, with dark red rim. Height 7.2 cm.

Figure 4.—M. P. 804. From the rubble outside Cave 29. Ladle or plate with looped handle. Light brown, with dark brown decoration. Diameter excluding handle 14.8 cm.

Figure 5.—M. P. 830. From Cave 29. Ladle or plate with conventional bird's head handle. Red, with decoration in dark red and black. Diameter excluding handle 14.8 cm.

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Explanation of Plate IX.

Figure 1.—M. P. 1012. From Cave 29. Two-handled dish. Red, with dark red rim. Height 10.5 cm.

Figure 2.—M. P. 1080. From Cave 29. Beaker-shaped olla. Dark brown, fire-blackened. Height excluding handle 14.5 cm.

Figure 3.—M. P. 856. From Cave 29. Pelike-shaped jug. Buff, with traces of red on rim and body. Height 19 cm.

Figure 4.—M. P. 887. From the rubble outside Cave 29. Pelike-shaped jug. Dark red, fire-blackened on one side. Height 17 cm.

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Explanation of Plate X.

Figures 1 and 2.—M. P. 930 and 931. From Cave 37. A pair of small two-handled dishes or saucers. White, with red rims and with butterfly designs in red, white and black. Diameters excluding handles 11.7 cm. and 12.3 cm.

Figure 3.—M. P. 847. From Cave 37. Two-handled dish. Brown, with design in red, white and black. Height 9.7 cm.

Figure 4.—M. P. 1007. From Cave 37. Small aryballus. Light brown, with decoration in red and black. Height 20.5 cm.

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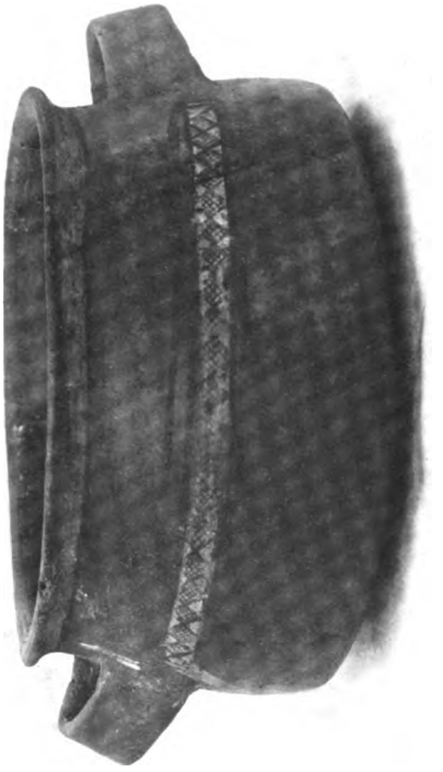

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Explanation of Plate XI.

Figure 1.—M. P. 863. From Cave 37. Small jug. The basal portions of the broken handle have been ground smooth. Height 15 cm.

Figure 2.—M. P. 946. From Cave 37. Small beaker-shaped olla. Light brown, fire-blackened. Height 9.5 cm.

Figure 3.—M. P. 808. From Cave 37. Ladle or plate with looped handle. Design in black and white on handle. Diameter excluding handle 15.3 cm.

Figure 4.—M. P. 806. From Cave 37. Ladle or plate with conventional bird's or llama's head handle. Light brown. Diameter excluding handle 13.7 cm.

Figure 5.—M. P. 801. From Cave 37. Ladle or plate with conventional bird's or llama's head handle. Light brown. Diameter excluding handle 14 cm.

Figure 6.—M. P. 802. From Cave 37. Ladle or plate with conventional bird's or llama's head handle. Light brown. Diameter excluding handle 15.9 cm.

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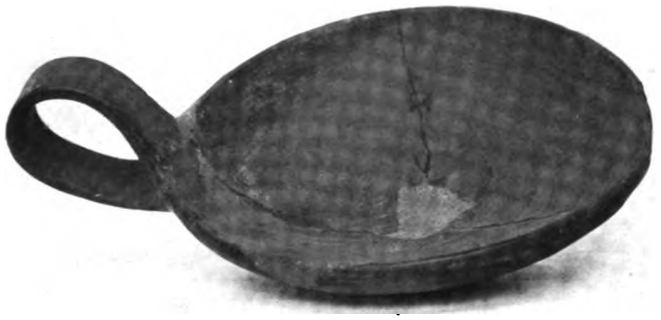

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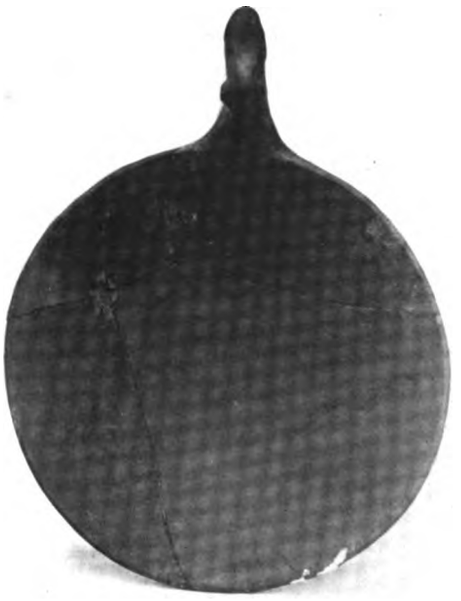

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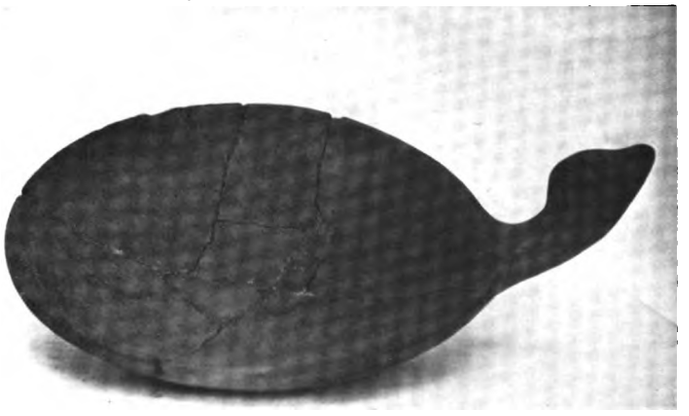

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Explanation of Plate XII.

Figure 1.—M. P. 1016. From Cave 37. Two-handled dish. Red, with designs in black and white on body and handles and beneath the rim. Height 11 cm.

Figure 2.—M. P. 820. From Cave 37. Concave pot-lid. Dark brown. Diameter 14.3 cm.

Figure 3.—M. P. 821. From Cave 37. Convex pot-lid. Red. Diameter 11.5 cm.

Figure 4.—M. P. 866. From Cave 37. Pelike-shaped jug. Dark red and white. Height 22.5 cm.

Figure 5.—M. P. 837. From Cave 37. Two-handled dish. Buff, with design in black and white. Height 11 cm.

Figure 6.—M. P. 846. From Cave 37. Two-handled dish. Red, with design in black and white on body; design in black on handles. Diameter excluding handles 24.1 cm.

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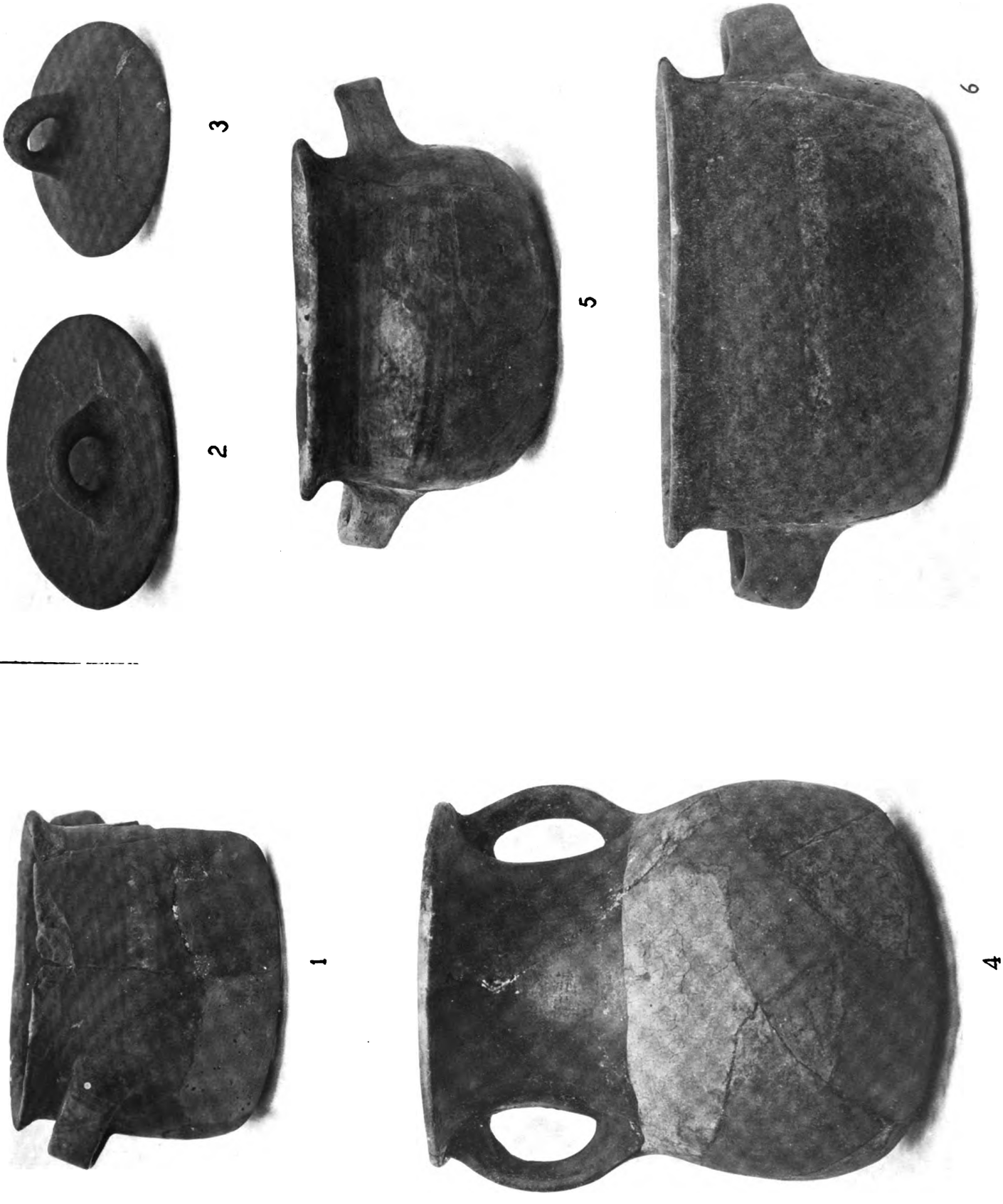

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Explanation of Plate XIII.

Figures 1 and 2.—M. P. 902 and 903. From Cave 52. A pair of pelike-shaped jugs. Red, with decoration in black and white on bodies, necks and handles; rims dark red with black margins. Heights 14.8 cm. and 14.9 cm.

Figure 3.—M. P. 815. From Cave 52. Ladle or plate. Decoration in red and white. Diameter of circular part 16.4 cm.

Figure 4.—M. P. 943. From Cave 52. Chicha jug. Fat man design in relief. Dark brown ware. Height 17 cm.

Figure 5.—M. P. 968. From Cave 52. Small broken ladle or plate. Dark brown ware. Diameter 12.5 cm.

Figures 6 and 7.—M. P. 827 and 828. From Cave 52. A pair of ladles or plates with conventional bird's head handles. Buff, with decoration in dark reddish-brown and white. Diameters excluding handles 13.8 cm. and 12.5 cm.

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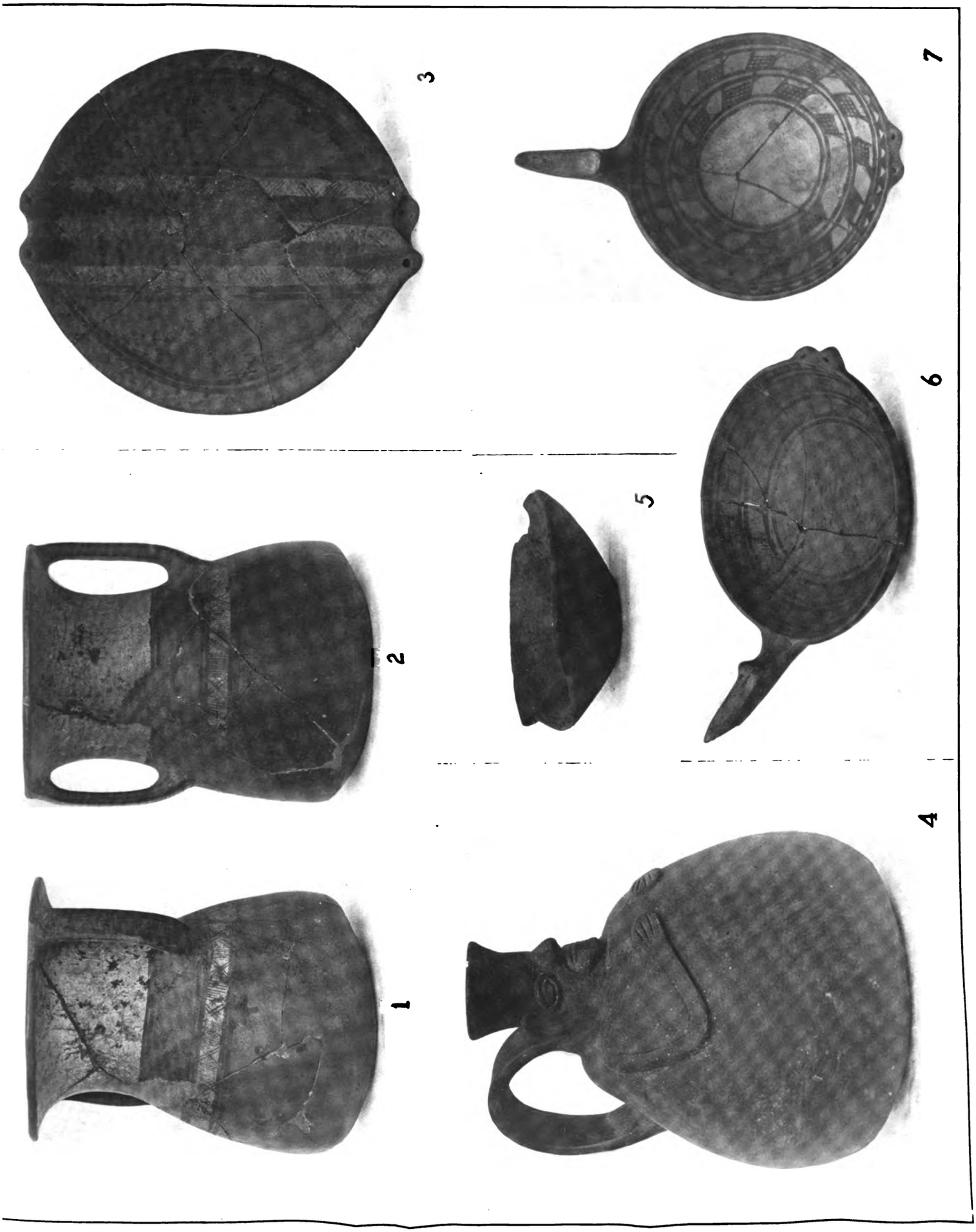

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Explanation of Plate XIV.

Figure 1.—M. P. 860. From Cave 101. Spherical flask. Dark brown. Height 23 cm.

Figure 2.—M. P. 913. From Cave 94. Three-legged brazier or fire-pot, with flat handle and ventilation holes. Fine brown ware, fire-blackened inside. Height including handle 14.5 cm.

Figure 3.—M. P. 1050. From Cave 94. Beaker-shaped olla, with second small handle in place of the usual ornament opposite the main handle. Fine dark brown ware, the base fire-blackened. Height excluding handle 15 cm.

Figure 4.—M. P. 936. From niche in rocks very near to Cave 48. Diota-shaped olla. Rough dark brown ware, fire-blackened. Height 26.7 cm.

Figure 5.—M. P. 895. From Cave 79. Two-handled "burial urn" in which a baby's skeleton was found. Rough dark brown ware, fire-blackened. Height 39 cm.

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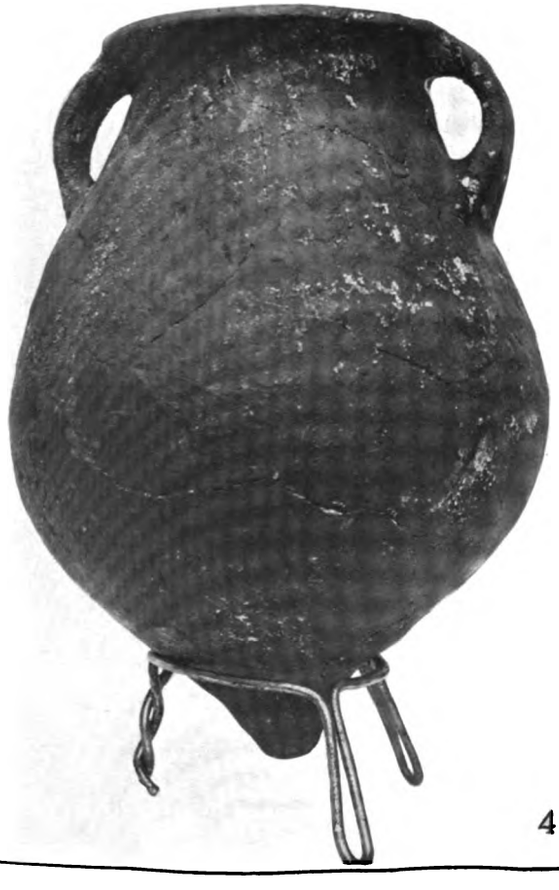

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Explanation of Plate XXXI.

Figure 1.—Ost. Coll. 3239. From Cave 84. Adult male pelvis. Anterior view.

Figure 2.—The same pelvis. Lateral view.

Figure 3.—The same pelvis. Superior view.

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Explanation of Plate XXXII.

Figure 1.—Right femur of the adult female human skeleton, Ost. Coll. 3157, found in Cave 3. The bone appears free from disease.

Figure 2.—Left femur of the same skeleton showing extensive syphilitic periostitis. The shaft, when found, was not fractured.

Figure 3.—Skiagram of the right femur of the same skeleton. Antero-posterior view.

Figure 4.—Skiagram of the left femur of the same skeleton. Antero-posterior view.

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Explanation of Plate XXXIII.

Figure 1.—Skiagram of the adult female human skull, Ost. Coll. 3165, found in Cave 11. Lateral view. A healed lesion appears near the right parietal eminence. See page 17.

Figure 2.—Skiagram of the vault of the same skull. The view was taken tangentially to the right parietal eminence, which appears at the upper-right corner of the illustration, in order to show the alterations produced in the cranial wall at this point by inflammatory disease.

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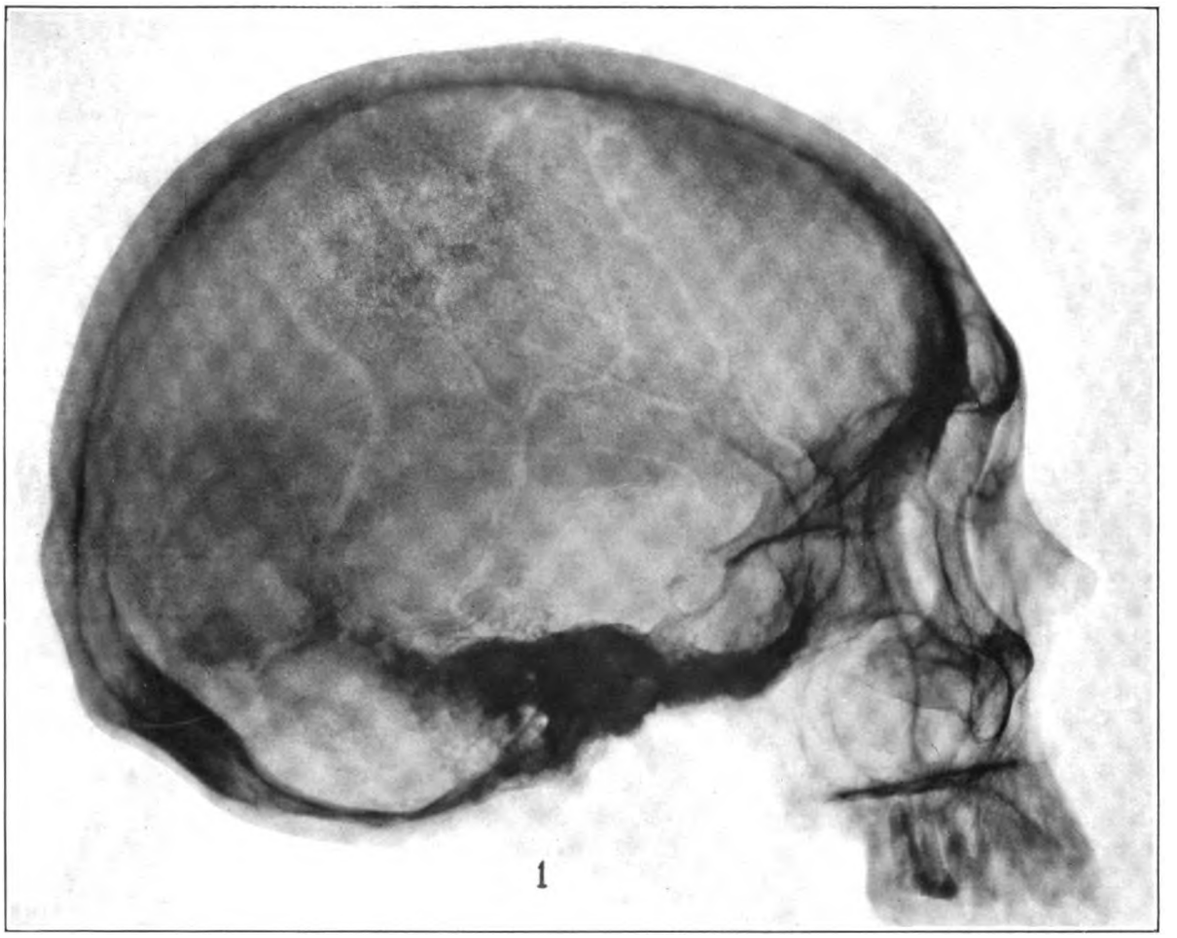

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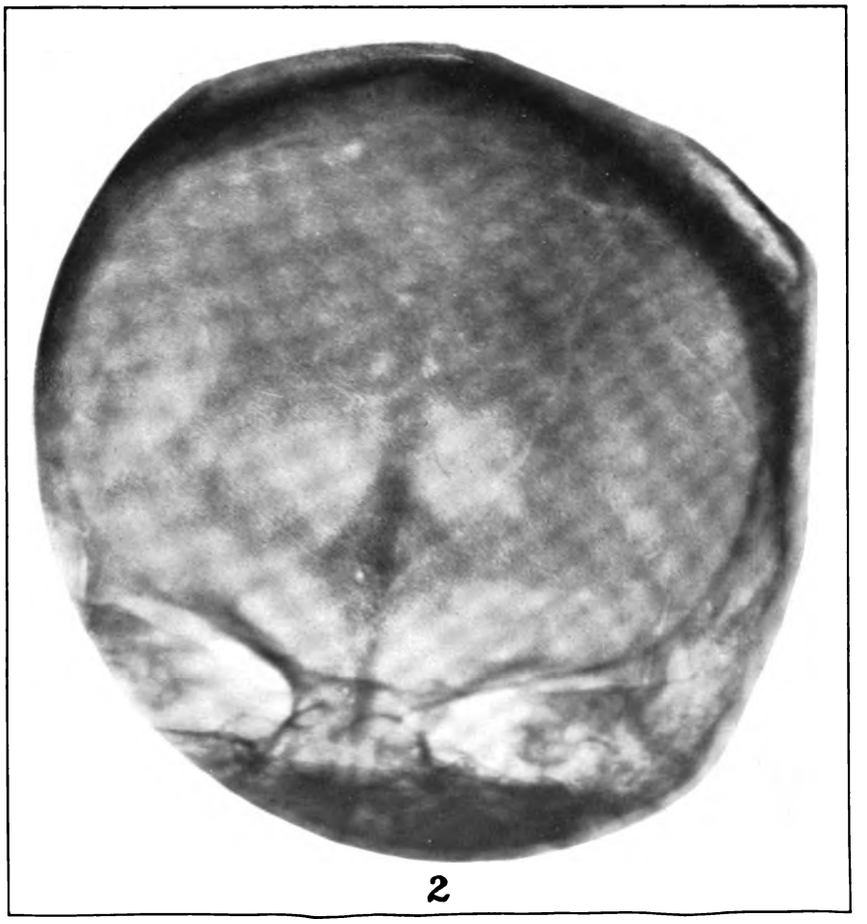

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Explanation of Plate XXXIV.

Femora and tibiæ of the adult female skeleton, Ost. Coll. 3175, found in Grave 26 in the Rock-sheltered Terrace. See page 29.

Figure 1.—Right femur, anterior aspect.

Figure 2.—Right tibia, anterior aspect, showing characteristic syphilitic periostitis of the shaft.

Figure 3.—Left tibia, anterior aspect, showing slight syphilitic periostitis of the shaft.

Figure 4.—Left femur, anterior aspect.

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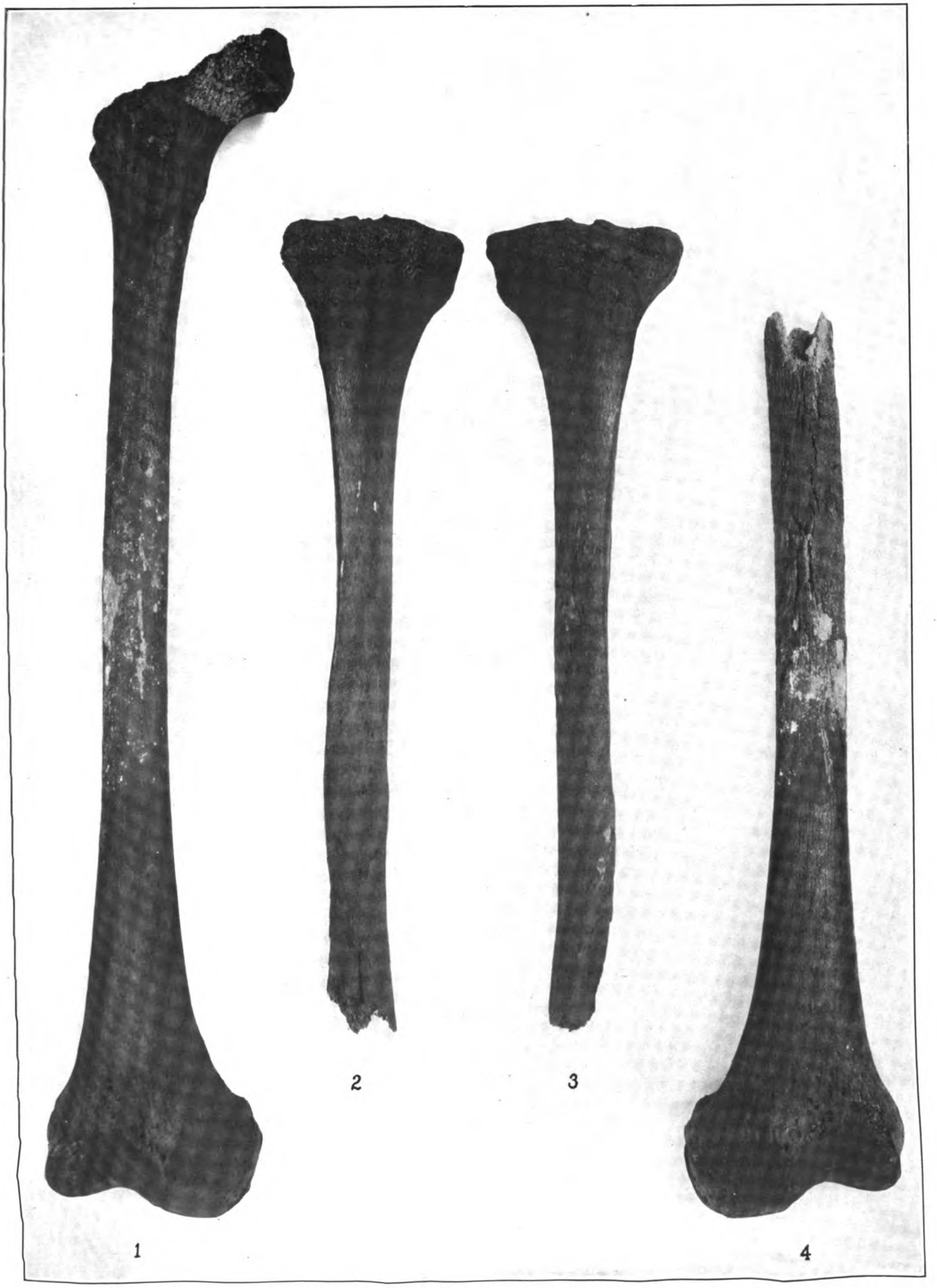

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Explanation of Plate XXXV.

Skiagrams of the femora and tibiæ of the adult female skeleton, Ost. Coll. 3175, found in Grave 26 in the Rock-sheltered Terrace. The views are taken in the antero-posterior direction. See page 29.

Figure 1.—Left femur.

Figure 2.—Left tibia.

Figure 3.—Right tibia.

Figure 4.—Right femur.

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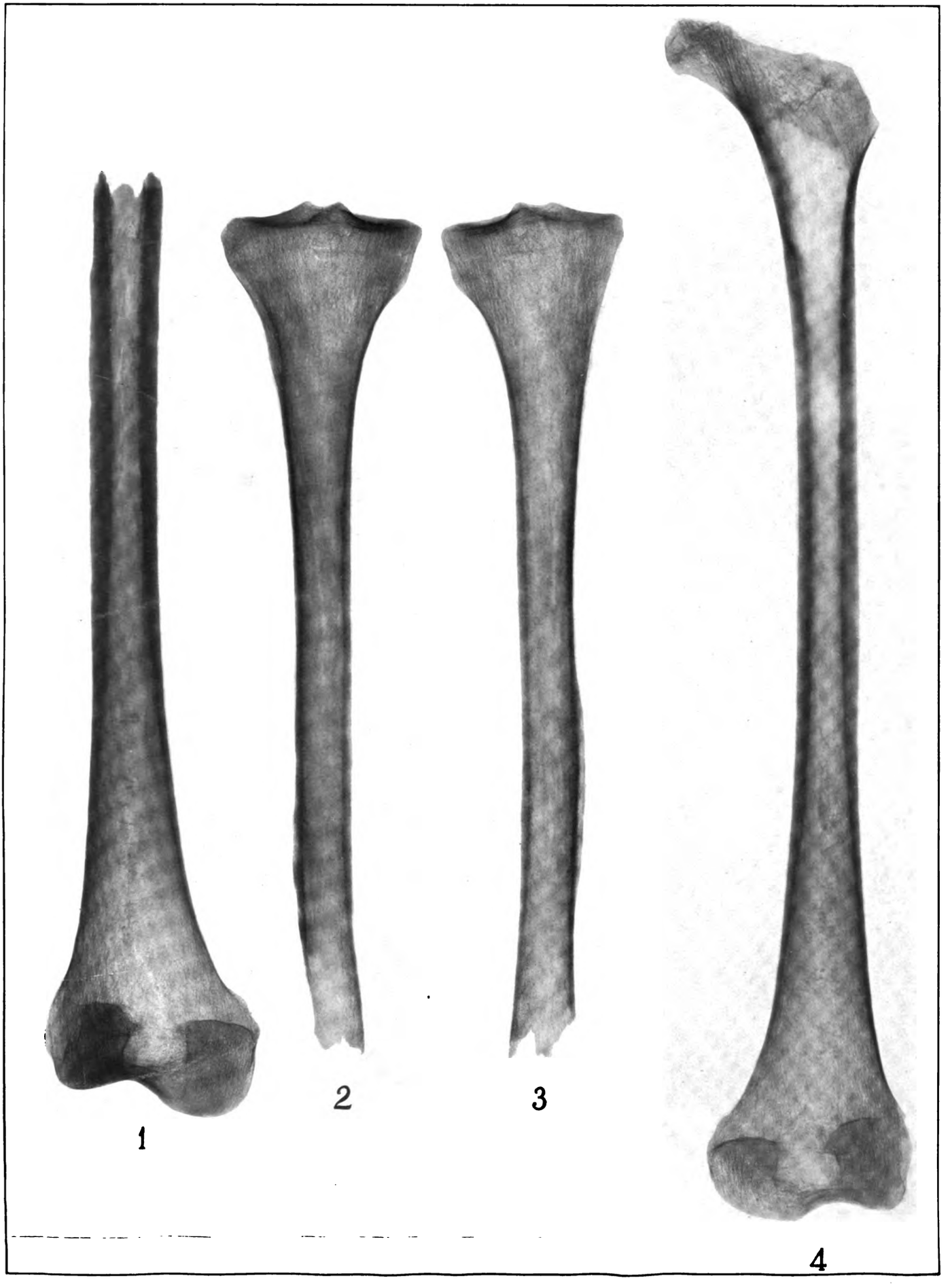

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Explanation of Plate XXXVI.

Tibiæ and fibulæ of the young male human skeleton, Ost. Coll. 3234, found in Cave 78. See page 68.

Figure 1.—Right fibula, anterior aspect.

Figure 2.—Right tibia, anterior aspect.

Figure 3.—Left tibia, anterior aspect, showing extensive syphilitic disease and resulting overgrowth of the shaft.

Figure 4.—Left fibula, anterior aspect. The bone is little or not at all affected by disease, and its length is approximately equal to that of the right fibula.

Figure 5.—Right tibia, medial aspect.

Figure 6.—Left tibia, medial aspect.

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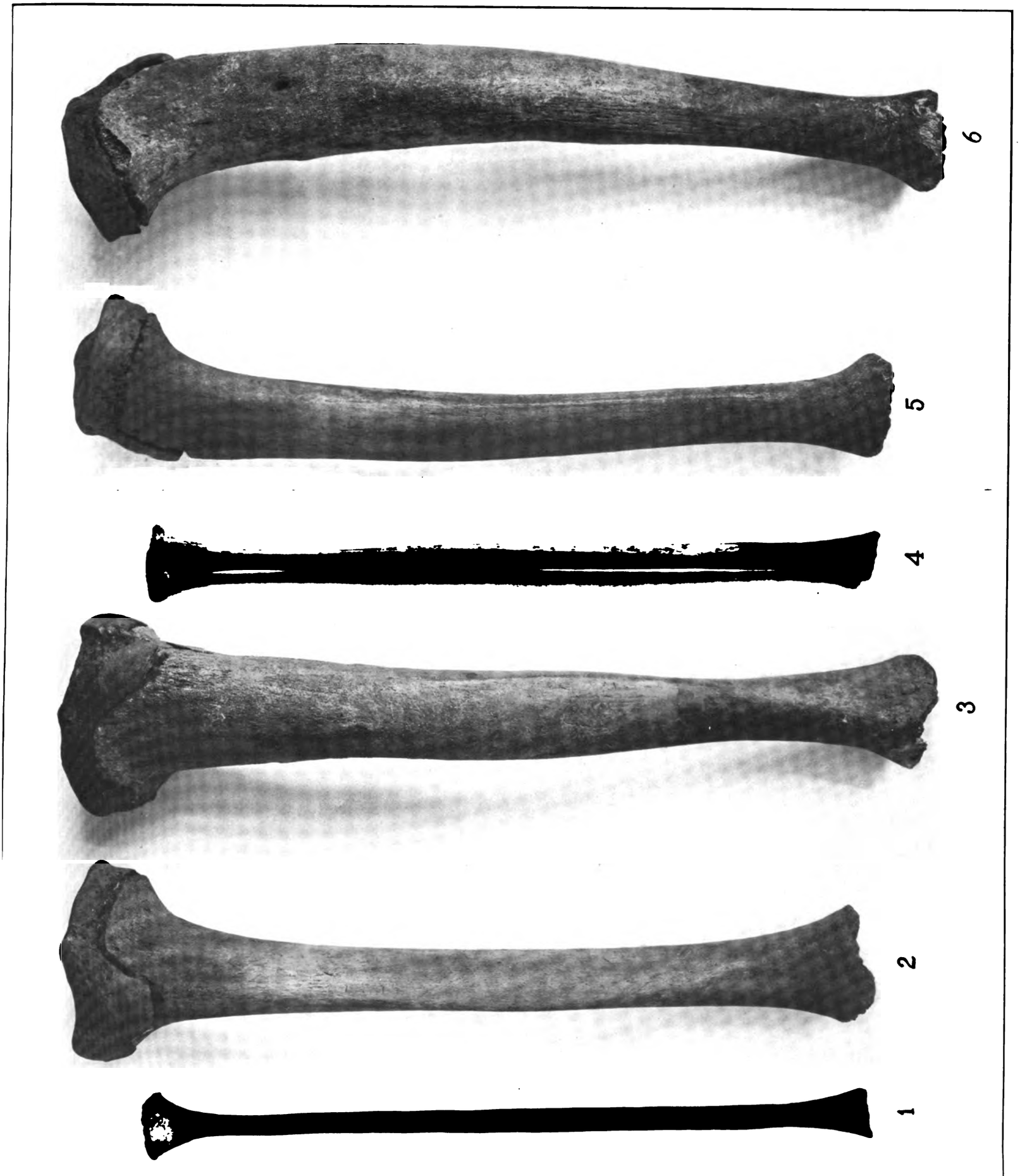

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Explanation of Plate XXXVII.

Skiagrams of the tibiæ of the young male human skeleton, Ost. Coll. 3234, found in Cave 78. See page 68.

Figure 1.—Left tibia, transverse view, showing extensive syphilitic disease.

Figure 2.—Right tibia, transverse view.

Figure 3.—Left tibia, antero-posterior view.

Figure 4.—Right tibia, antero-posterior view.

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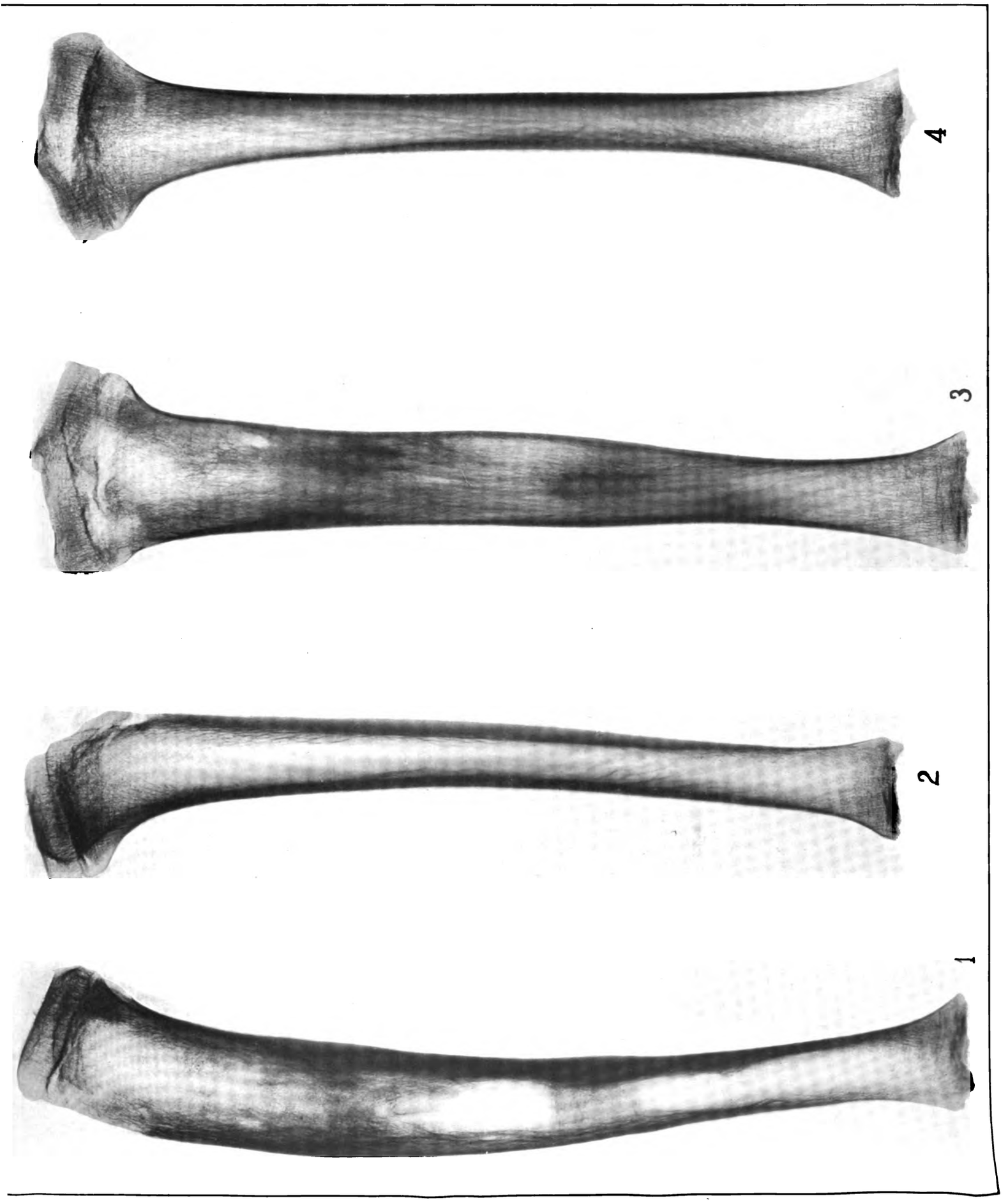

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Explanation of Plate XXXVIII.

Figures 1, 2, 3.—Skull of *Abrocoma oblativa,* sp. nov. (type), Yale Univ. Ost. Coll. 3320. Natural size.

Figures 4, 5.—Mandible of the same skull. Natural size.

Figures 6, 7.—Skull of *Agouti thomasi,* sp. nov., Yale Univ. Ost. Coll. 3316. Natural size.

Figure 8.—Mandible of *Agouti thomasi,* sp. nov., Yale Univ. Ost. Coll. 3326. Natural size.

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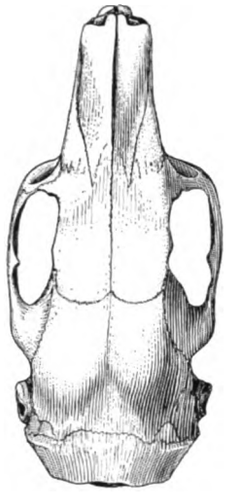

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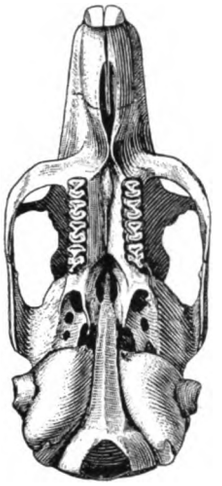

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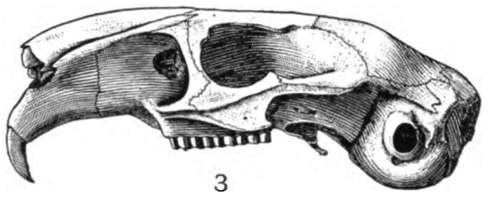

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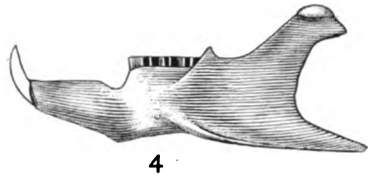

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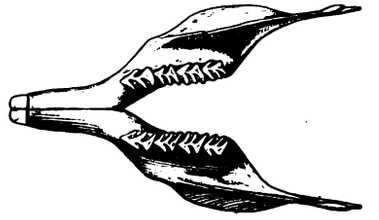

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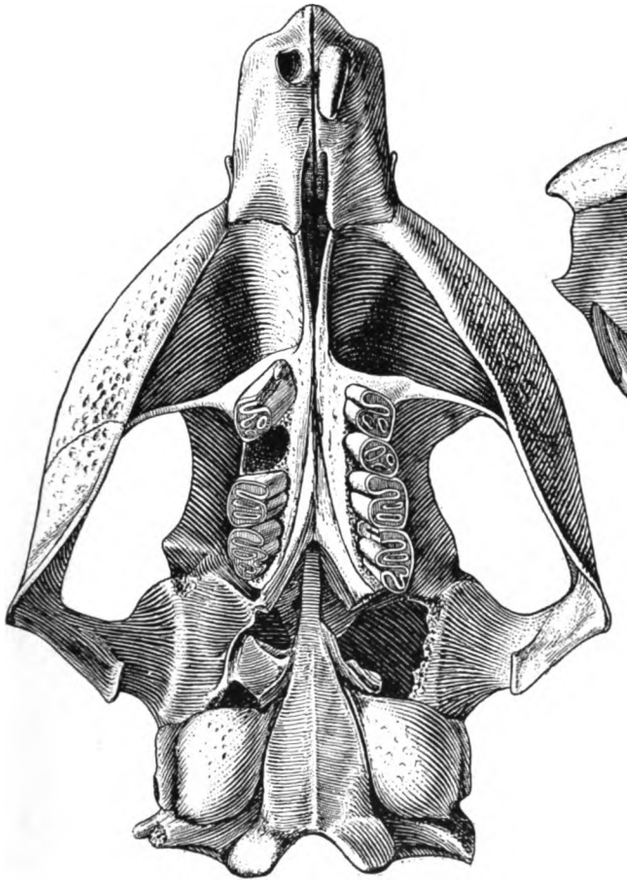

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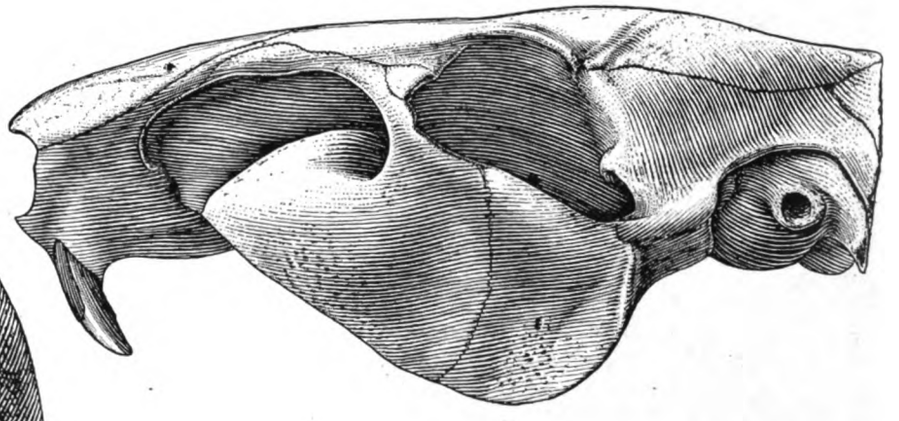

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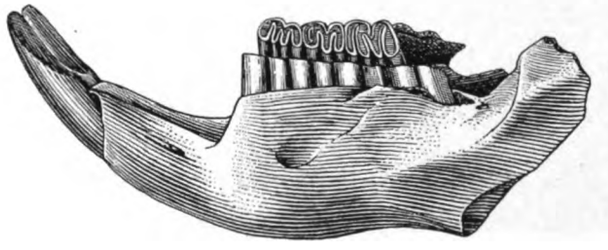

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Explanation of Plate XXXIX.

Figures 1, 2, 3.—Skull of *Agouti thomasi,* sp. nov. (type), Yale Univ. Ost. Coll. 3327. Natural size.

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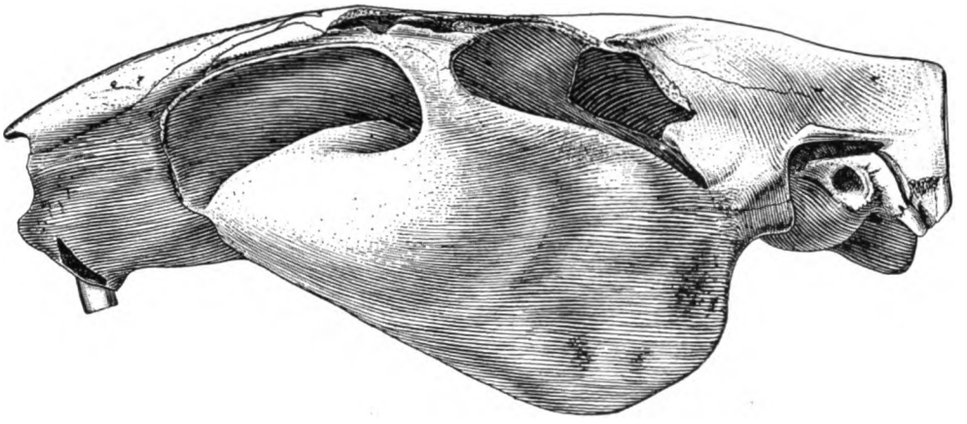

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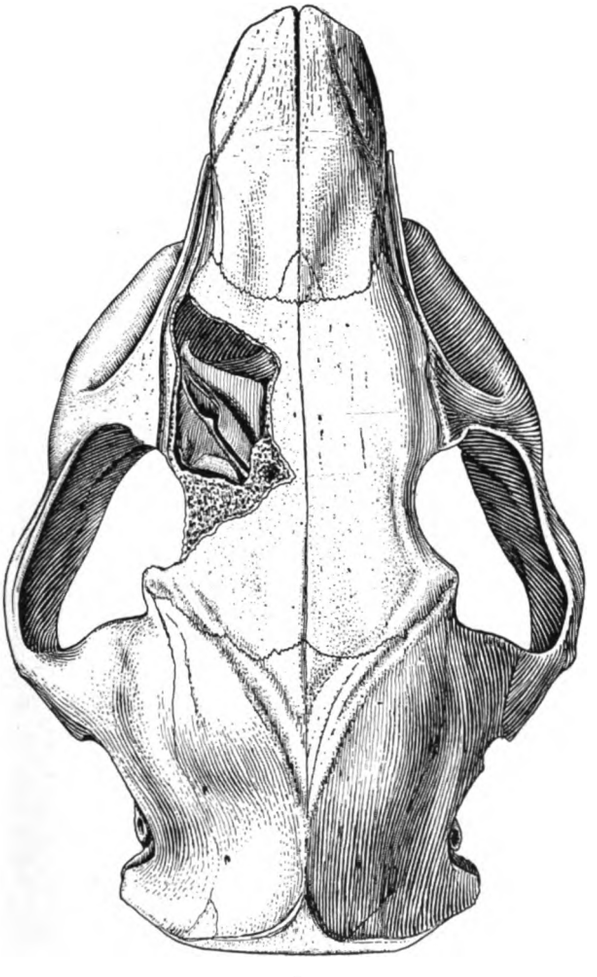

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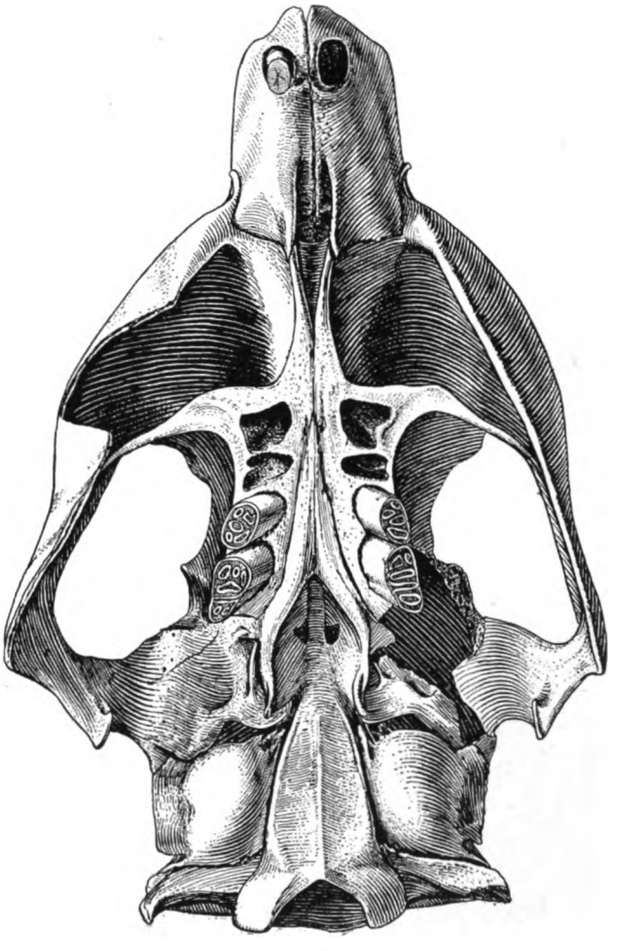

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above T. P. Suture.

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above T. P. Suture.	Menton-Nasion Height (a).	Prosth.-Nasion Height (b).	Diam. Bizyg. Max. (c).	Foramen Mag. Mean Diam.	Circumference, Max. above ridges.	Arc, Nasion-Opisth.	Arc, Nasion-Bregma.	Arc, Bregma-Lambda.	Arc, Lambda-Opisth.
-5	11.7	6.8	13.9	3.1	49.2	35.3	11.8	11.7	11.8
-3	10.6	6.2	12.5	3.25	48.0	35.0	12.1	11.7	11.2
-5	....	....	13.3	3.4	49.2	37.2	12.7	12.8	11.7
-4	10.8	6.8	13.1	3.2	48.6	35.6	11.2	11.0	13.4*
-5	10.8	6.7	....	....	51.1	36.1	12.7	11.2	12.2*
-6	....	....	....	....	....	38.3	13.9	12.0	12.4
-5.5	10.8	6.7	13.4	3.2	50.2	35.6	11.6	11.3	12.8
-5	12.7	7.5	....	3.0	45.9	38.1	12.2	13.9	12.0
-5	12.8	8.0	....	....	....	37.0	12.8	10.6	13.6
-5	....	....	....	3.55	....	....	12.5	....	....
-5	11.8	7.1	13.5	3.25	49.5	35.1	11.6	10.0	13.5*
-5	10.8	6.45	12.8	3.0	47.3	35.7	12.2	12.6	10.9
-4	10.4	6.5	12.7	3.2	48.0	33.6	11.6	11.2	10.8
-3	...	....	....	3.25	....	34.6	12.4	11.6	10.6
-5	11.1	6.9	13.3	3.25	47.2	35.6	12.0	12.6	11.0
-4	....	6.2	13.0	3.0	47.0	33.5	11.4	11.4	10.7
-5	10.9	6.5	12.8	3.2	49.8	36.2	12.3	12.1	11.8
-4	11.0	6.7	13.1	3.15	....	....	....	12.1	11.2
-5	....	5.9	12.6	2.65	47.0	35.1	11.2	10.6	13.3
-4	9.8	5.9	11.8	3.15	49.3	35.3	12.4	9.9	13.0*
-4	11.4	6.8	....	3.0	49.1	36.3	11.6	13.3	11.4
-4	10.4	6.2	....	3.0	46.0	32.2	10.7	11.1	10.4
-5	10.2	....	12.8	3.15	48.0	35.0	12.4	11.5	11.1
-4	....	6.7	....	....	44.7	....	....	12.4	....
-6	....	....	12.5	3.05	....	....	....	10.6	12.1
-5	....	....	....	2.7	46.4	35.9	11.8	12.5	11.6
-4	....	5.9	12.4	2.8	47.0	33.4	12.1	10.0	11.3
-5	....	6.95	13.0	3.05	48.0	34.4	12.2	11.5	10.7
..	11.0	6.9	12.2	....	....	34.8	12.2	11.1	11.5
-4	....	....	12.7	2.8	48.2	37.4	13.2	12.5	11.7
-6	....	6.7	12.7	3.0	[illegible]				
-4	10.4	6.3	12.1						

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TABLE II.—HUMAN PELVES FRO

Measurements in mil

	Catalogue Number, Y. U. Ost. Coll.	3173	3194	3221	3238
	Serial Number of Cave or Grave	23	41	63	84
	Sex	Male	Male	Male	Male
	Approximate Age of Subject	16	30	40	20
1.	Breadth of pelvis	265	*248*	270	*256*
2.	Height of pelvis	185	176	197	...
3.	*Breadth-Height Index*	70	*71*	73	...
4.	Between ant. sup. iliac spines	242	...	240	...
5.	Between post. sup. iliac spines	62	...	54	...
6.	Between ischial tubera	137	...	126	...
7.	Between ischial spines	87	...	81	...
8.	Greatest diameter of cotyloid	51v	48v	49v	51v
9.	Vertical diameter of obturator foramen	45	47	56	...
10.	Transverse diameter of obturator foramen	32	34	40	...
11.	*Obturator Index*	71	*72*	71	...
12.	Subpubic angle	67°	*60°*	60°	67°
13.	Transverse diameter of brim	133	*124*	132	121
14.	Conjugate diameter of brim	99	74	94	*86*
15.	*Pelvic* or *Brim Index*	74	*60*	71	*71*
16.	Oblique diameter of brim { Right	120	...	123	...
	{ Left	120	...	122	...
17.	Inferior sagittal diameter	101	...	104	...
18.	Coccygeo-pubic diameter	...	...	...	...
19.	Intertuberal diameter	109	...	105	...
20.	Depth of pubic symphysis	31	...	38	35
21.	Depth of pelvic cavity	85	83	89	81
22.	Height-length of ilium	114	103	114	*113*
23.	Breadth of ilium	134	131	141	*143*
24.	*Iliac Index*	119	127	124	*127*
25.	Breadth of innominate bone	134	121	136	...
26.	Length of os pubis	69	63	78	...
27.	*Pubo-innominate Index*	52	...	57	...
28.	Length of ischium	74	74	85	*81*
29.	*Innominate Index*	72	69	69	...
30.	*Ischio-innominate Index*	40	...	43	...
31.	Length of sacrum	102	97	91	89
32.	Breadth of sacrum	112	*96*	116	102
33.	*Sacral Index*	110	*99*	127	121

Approximate measurements and indices derived from them are entered in italics.

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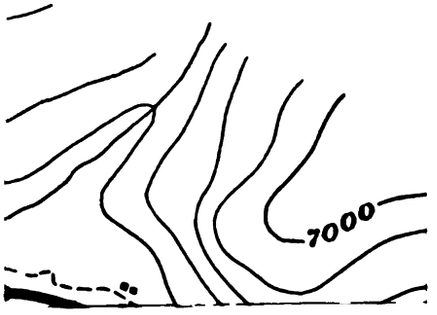

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